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Every day, weather balloons rise up, up, and away into the air to gather climate data.
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Tiny air bubbles trapped in ancient ice can help scientists figure out what the climate was like hundreds of thousands of years ago.
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Warmer temperatures mean that some hibernating animals are getting an earlier wakeup call in the spring.

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A hybrid car can go up to twice as far on a gallon of gasoline as a typical gasoline–powered car.

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Learn the Basics

The Earth's climate is changing, and people's activities are the main cause.

Our world is always changing. Look out your window long enough, and you might see the weather change. Look even longer, and you'll see the seasons change. The Earth's climate is changing, too, but in ways that you can't easily see.

The Earth is getting warmer because people are adding heat-trapping gases to the atmosphere, mainly by burning fossil fuels. These gases are called greenhouse gases. Warmer temperatures are causing other changes around the world, such as melting glaciers and stronger storms. These changes are happening because the Earth's air, water, and land are all linked to the climate. The Earth's climate has changed before, but this time is different. People are causing these changes, which are bigger and happening faster than any climate changes that modern society has ever seen before.

- Learn more about the climate.
- Find out how and why the climate is changing.
- Learn how the climate changed in the past.

The Greenhouse Effect

Certain gases in the atmosphere keep the Earth warm through a process called the greenhouse effect. Watch a brief animation to learn more about the greenhouse effect and how people are causing it to become stronger.

Last updated on 3/3/2016

Climate Concepts

Climate is what we expect, weather is what we get. *– Mark Twain*

Climate refers to the average weather conditions in a certain place over many years. For example, the climate in Minnesota is cold and snowy in the winter, and the climate in Honolulu, Hawaii, is warm and humid all year long. The climate in one area, like the Midwest or Hawaii, is called a regional climate. The average climate around the world is called global climate.

When scientists talk about global climate change, they're talking about the global climate and a pattern of change that's happening over many years. One of the most important trends that scientists look at is the average temperature of the Earth, which has been increasing for many years. This is called global warming.

Rising global temperatures lead to other changes around the world, such as stronger hurricanes, melting glaciers, and the loss of wildlife habitats. That's because the Earth's air, water, and land are all related to one another and to the climate. This means a change in one place can lead to other changes somewhere else. For example, when air temperatures rise, the oceans absorb more heat from the atmosphere and become warmer. Warmer oceans, in turn, can cause stronger storms.

This diagram shows how global warming can lead to a variety of other changes.

Weather Versus Climate

- **Weather** is a specific event or condition that happens over a period of hours or days. For example, a thunderstorm, a snowstorm, and today's temperature all describe the weather.
- **Climate** refers to the average weather conditions in a place over many years (usually at least 30 years). For example, the climate in Minneapolis is cold and snowy in the winter, while Miami's climate is hot and humid. The average climate around the world is called global climate.

Weather conditions can change from one year to the next. For example, Minneapolis might have a warm winter one year and a much colder winter the next. This kind of change is normal. But when the average pattern over many years changes, it could be a sign of climate change.

Here's an easy way to remember the difference between weather and climate: Climate helps you decide what clothes to buy, and weather helps you decide what clothes to wear each day.

1. Imagine that last summer was much hotter than usual where you live. Is this a sign of climate change? Yes or no?
   No. The weather naturally varies from year to year, and some years are hotter than others.

2. Imagine that almost every summer for the past decade has been hotter than usual. Is this a sign of climate change? Yes or no?
   Yes. Climate change occurs over many years, so a pattern of many hotter summers could be

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Today's Climate Change

More than 100 years ago, people around the world started burning large amounts of coal, oil, and natural gas to power their homes, factories, and vehicles. Today, most of the world relies on these fossil fuels for their energy needs. Burning fossil fuels releases carbon dioxide, a heat-trapping gas, into the atmosphere, which is the main reason why the climate is changing.

Heat-trapping gases are also called greenhouse gases. They exist naturally in the atmosphere, where they help keep the Earth warm enough for plants and animals to live. But people are adding extra greenhouse gases to the atmosphere. These extra gases are causing the Earth to get warmer, setting off all sorts of other changes around the world—on land, in the oceans, and in the atmosphere. And these changes affect people, plants, and animals in many ways.

Learn more about carbon dioxide and other greenhouse gases and how they are changing the Earth's climate:

- The Greenhouse Effect
- Greenhouse Gases
- All About Carbon Dioxide

Climate Challenge

1. Which of the following statements are true? Reveal answer

   A. The Earth's average temperature has increased since the late 1800s, when people started burning a lot of coal, oil, and natural gas.
   B. Worldwide, 2001–2010 was the warmest decade ever recorded.
   C. In the United States, seven of the top 10 warmest years on record have occurred since 1990.

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Last updated on 3/3/2016

The Greenhouse Effect

If it were not for greenhouse gases trapping heat in the atmosphere, the Earth would be a very cold place. Greenhouse gases keep the Earth warm through a process called the greenhouse effect. Play the video to learn more »

The Earth gets energy from the sun in the form of sunlight. The Earth's surface absorbs some of this energy and heats up. That's why the surface of a road can feel hot even after the sun has gone down—because it has absorbed a lot of energy from the sun. The Earth cools down by giving off a different form of energy, called infrared radiation. But before all this radiation can escape to outer space, greenhouse gases in the atmosphere absorb some of it, which makes the atmosphere warmer. As the atmosphere gets warmer, it makes the Earth's surface warmer, too.

Learn more about radiation.

Learn where the term "greenhouse effect" comes from.

Greenhouse gases keep the Earth warm through a process called the greenhouse effect.

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What's in a Name? The "Greenhouse Effect"

close

A greenhouse is a building made of glass that allows sunlight to enter but traps heat inside, so the building stays warm even when it's cold outside. Because gases in the Earth's atmosphere also let in light but trap heat, many people call this phenomenon the "greenhouse effect." The greenhouse effect works somewhat differently from an actual greenhouse, but the name stuck, so that's how we still refer to it today.

"HOW LONG?" ANSWER: Some greenhouse gases stay in the atmosphere for only a short time, but others can stay in the atmosphere and affect the climate for thousands of years.

"HOW POWERFUL?" ANSWER: Not all greenhouse gases are created equal! Some trap more heat than others. For example, one pound of methane traps about 21 times as much heat as one pound of carbon dioxide.

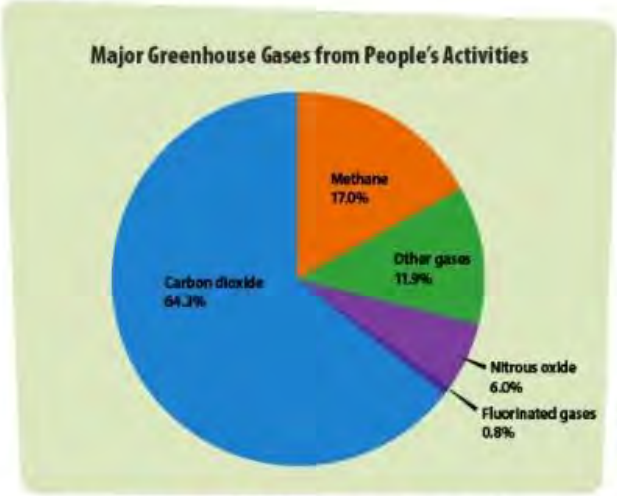
Greenhouse Gases

Greenhouse gases trap heat in the atmosphere, which makes the Earth warmer. People are adding several types of greenhouse gases to the atmosphere, and each gas's effect on climate change depends on three main factors:

How much? | **How long?** | **How powerful?**

People produce larger amounts of some greenhouse gases than others. Carbon dioxide is the greenhouse gas you hear people talk about the most. That's because we produce more carbon dioxide than any other greenhouse gas, and it's responsible for most of the warming.

Carbon dioxide is the most important greenhouse gas emitted by humans, but several other gases contribute to climate change, too. ***Learn more about the major greenhouse gases by selecting pieces of the pie chart below.***



The size of each piece of the pie represents the amount of warming that each gas is currently causing in the atmosphere as a result of emissions from people's activities. *Source: Intergovernmental Panel on Climate Change, Fifth Assessment Report (2014).*

Water Vapor: It's a Gas!

Water can take the form of an invisible gas called water vapor. Water vapor is naturally present in the atmosphere and has a strong effect on weather and climate.

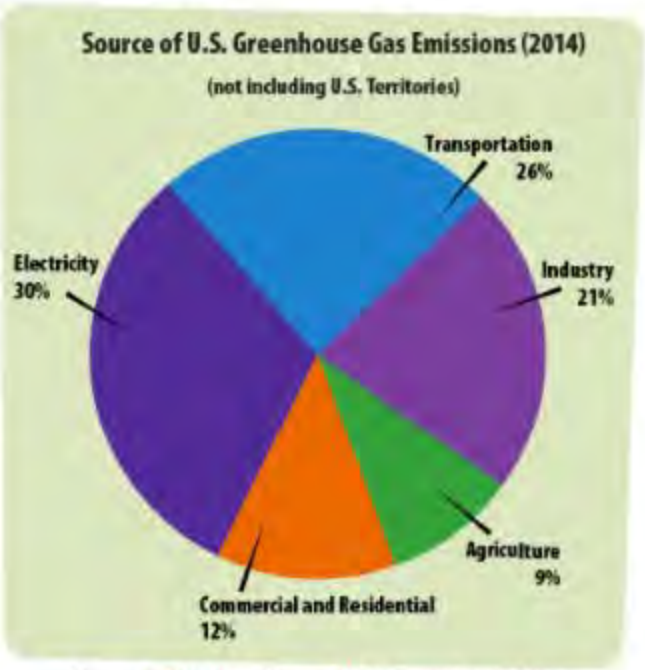
As the planet gets warmer, more water evaporates from the Earth's surface and becomes vapor in the atmosphere. Water vapor is a greenhouse gas, so more water vapor in the atmosphere leads to even more warming. This is an example of a *positive feedback loop*, which happens when warming causes changes that lead to even more warming.

The size of each piece of the pie represents the amount of warming that each gas is currently causing in the atmosphere as a result of emissions from people's activities. *Source: Intergovernmental Panel on Climate Change, Fifth Assessment Report (2014).*

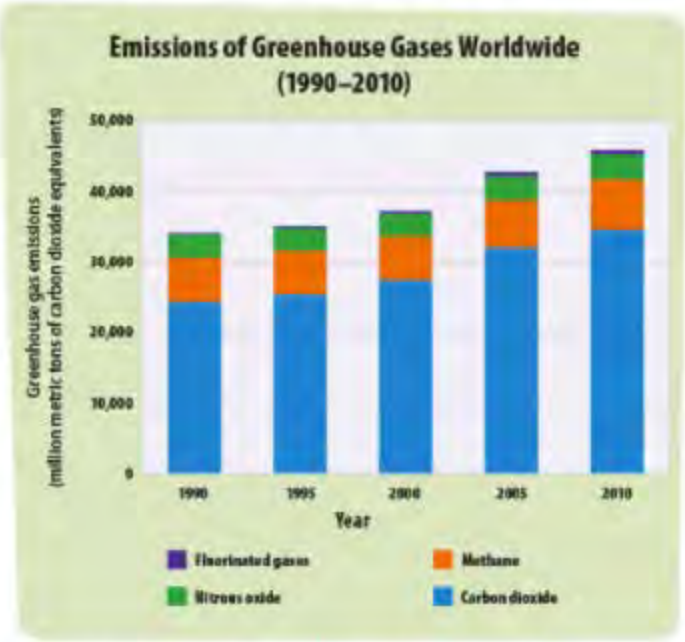
evaporates from the Earth's surface and becomes vapor in the atmosphere. Water vapor is a greenhouse gas, so more water vapor in the atmosphere leads to even more warming. This is an example of a *positive feedback loop*, which happens when warming causes changes that lead to even more warming.

Greenhouse gases come from all sorts of everyday activities, such as using electricity, heating our homes, and driving around town. The graph to the right shows which activities produce the most greenhouse gases in the United States.

These greenhouse gases don't just stay in one place after they're added to the atmosphere. As air moves around the world, greenhouse gases become globally mixed, which means the concentration of a greenhouse gas like carbon dioxide is roughly the same no matter where you measure it. Even though some countries produce more greenhouse gases than others, emissions from *every* country contribute to the problem. That's one reason why climate change requires global action. The graph below shows how the world's total greenhouse gas emissions are continuing to increase every year.



Source: EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks (2016).



Source: EPA's Climate Change Indicators (2016).

All About Carbon Dioxide

Carbon is an element that's found all over the world and in every living thing. Oxygen is another element that's in the air we breathe. When carbon and oxygen bond together, they form a colorless, odorless gas called carbon dioxide, which is a heat-trapping greenhouse gas. Whenever we burn fossil fuels such as coal, oil, and natural gas—whether it's to drive our cars, use electricity, or make products—we are producing carbon dioxide.

The atmosphere isn't the only part of the Earth that has carbon. The oceans store large amounts of carbon, and so do plants, soil, and deposits of coal, oil, and natural gas deep underground. Carbon naturally moves from one part of the Earth to another through the carbon cycle. But right now, by burning fossil fuels, people are adding carbon to the atmosphere (in the form of carbon dioxide) faster than natural processes can remove it. That's why the amount of carbon dioxide in the atmosphere is increasing, which is causing global climate change.

Check out this video to learn more about the carbon cycle and how people are changing its natural balance.

People are adding carbon dioxide to the atmosphere faster than it can be removed.

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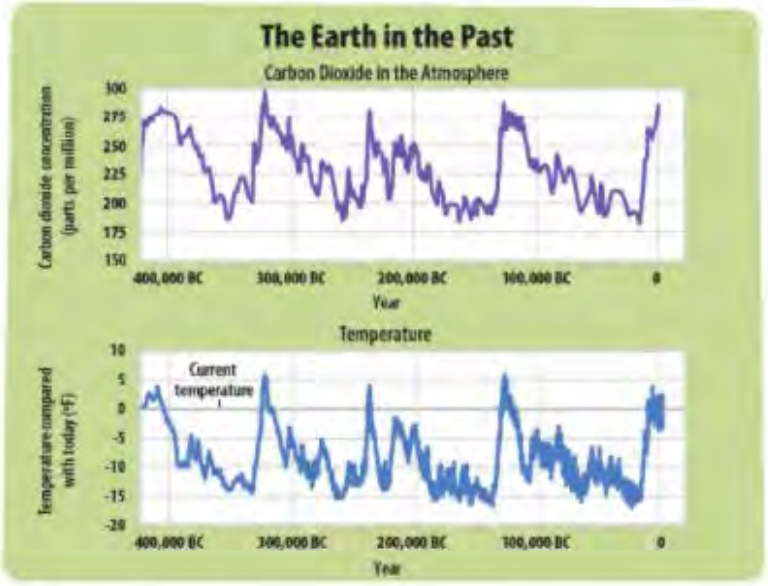
The Earth's Climate in the Past

The Earth was formed about 4.5 billion years ago—that's a very long time ago! It's hard to say exactly what the Earth's daily weather was like in any particular place on any particular day thousands or millions of years ago. But we know a lot about what the Earth's *climate* was like way back then because of clues that remain in rocks, ice, trees, corals, and fossils.

These cues tell us that the Earth's climate has changed many times before. There have been times when most of the planet was covered in ice, and there have also been much warmer periods. Over at least the last 650,000 years, temperatures and carbon dioxide levels in the atmosphere have increased and decreased in a cyclical pattern. Can you see this pattern in the graph below?



These graphs are based on the Vostok ice core from Antarctica. They do not include the most recent increases in carbon dioxide and temperature caused by humans. Notice the strong connection between carbon dioxide and temperature. *Source: EPA's Climate Change Indicators (2016) and Petit et al. (2001).*

People didn't cause the climate change that occurred thousands or millions of years ago, so it must have happened for other natural reasons.

Explore the list below to learn about some natural factors that have changed the Earth's climate in the past.

▾ **Changes in the Earth's orbit**

Today's Climate Change Is Different!

Today's climate change is different from past climate change in several important ways:

- **Natural causes are not responsible.** None of the natural causes of climate change, including variations in the sun's energy and the Earth's orbit, can fully explain the climate changes we are seeing today. Learn more about how we know this.
- **People's activities are the main cause.** By burning lots of fossil fuels like coal, oil, and natural gas, people are overloading the atmosphere with carbon dioxide and adding to the greenhouse effect People are also adding other heat-trapping greenhouse gases, such as methane and nitrous oxide, to the atmosphere.
- **Greenhouse gases are at record levels in the atmosphere.** For hundreds of thousands of years, the concentration of carbon dioxide in the atmosphere stayed between 200 and 300 parts per million. Today, it's up to nearly 400 parts per million, and the amount is still rising. Along with other greenhouse gases, this extra carbon dioxide is trapping heat and causing the climate to change.

These two graphs show how the amount of carbon dioxide and the Earth's temperature have increased since the year 1901.

The shape of the Earth's orbit around the sun naturally changes over time, and so does the way the Earth tilts toward the sun. Many of these changes happen in cycles that repeat over tens of thousands of years. These changes affect how much of the sun's energy the Earth absorbs, which in turn affects the Earth's temperature. Over at least the last few million years, these cycles likely caused the Earth to alternate between cold and warm periods. For the last few thousand years, we've been in a relatively warmer period.

About 20,000 years ago, ice sheets covered large parts of North America, where they extended as far south as where Chicago is now. In some places, this ice was a mile deep!
Source: Adapted from NASA (2011).

Changes in the sun's energy

The sun goes through sunspot cycles every 11 years or so. During times when there are sunspots, dark spots—some as big as 50,000 miles wide—move across the surface of the sun. When this happens, the sun gives off slightly more energy, which makes the Earth a bit warmer. The sun also goes through longer term changes that affect how much energy it gives off.

Photosynthesis

The Earth's first billion years were very different from the conditions today. The sun was cooler then, but the planet was generally warmer. That's because there were a lot of greenhouse gases, like carbon dioxide and methane, in the atmosphere. Also, the atmosphere back then contained very little oxygen. It was a very different world—a world without people or the kinds of plants and animals that thrive in today's climate. But photosynthesis, which became common about 2 billion years ago, changed all that. During photosynthesis, plants take carbon dioxide out of the atmosphere and replace it with

Volcanic eruptions

When volcanoes erupt, they spew more than red hot lava! They also add carbon dioxide to the atmosphere, along with dust, ash, and other particles called aerosols. At certain times during the history of the Earth, some very active volcanoes added a lot of carbon dioxide to the atmosphere, causing the planet to get warmer. However, most of the time, including today, the major effect from volcanoes is actually cooling the Earth because aerosols block some sunlight from reaching us. If an eruption is big enough to launch these particles high into the atmosphere, it can lead to slightly cooler temperatures around the world for a few

Scientists around the world agree that today's global climate change is mainly caused by people's activities.

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See the Impacts

Scorching summers... Melting glaciers... Stronger storms...
The signs of global climate change are all around us.

Source: NASA/courtesy of nasaimages.org.

The Earth's climate is getting warmer, and the signs are everywhere. Rain patterns are changing, sea level is rising, and snow and ice are melting sooner in the spring. As global temperatures continue to rise, we'll see more changes in our climate and our environment. These changes will affect people, animals, and ecosystems in many ways.

Less rain can mean less water for some places, while too much rain can cause terrible flooding. More hot days can dry up crops and make people and animals sick. In some places, people will struggle to cope with a changing environment. In other places, people may be able to successfully prepare for these changes. The negative impacts of global climate change will be less severe overall if people reduce the amount of greenhouse gases we're putting into the atmosphere and worse if we continue producing these gases at current or faster rates.

- Learn about the changes happening in the Earth's climate system now and the changes expected in the future.
- Find out how these changes will affect people and the environment.

TAKE A CLIMATE CHANGE EXPEDITION!
join us!

Observing Our World

EPA uses indicators to track how the environment changes over time. What do EPA's indicators tell us about the causes and effects of climate change? View a slide show to learn more.

did you know?

The world's oceans are warmer now than at any point in the last 50 years.

Last updated on 8/20/2015

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GLOBAL CLIMATE CHANGE

The Signs of Climate Change

The average temperature of the Earth is rising, but that's not the only way we can tell the climate is changing. In fact, the signs are all around us! Observations and measurements from all over the world provide strong evidence that the climate has already started to change.

Learn more about some of the signs of global climate change and what additional changes we'll see in the future:

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Last updated on 3/3/2016

Higher Temperatures

Greenhouse gases are trapping more heat in the Earth's atmosphere, which is causing average temperatures to rise all over the world.

Higher Temperatures
Changing Rain and Snow Patterns
More Droughts
Warmer Oceans
Rising Sea Level
Wilder Weather

What's happening now?

Temperatures have risen during the last 30 years, and 2001 to 2010 was the warmest decade ever recorded. As the Earth warms up, heat waves are becoming more common in some places, including the United States. Heat waves happen when a region experiences very high temperatures for several days and nights.

What will happen in the future?

The choices we make now and in the next few decades will determine how much the planet's temperature will rise. While we are not exactly sure how fast or how much the Earth's average temperature will rise, we know that:

- If people keep adding greenhouse gases into the atmosphere at the current rate, the average temperature around the world could increase by about 4 to 12°F by the year 2100.
- If we make big changes, like using more renewable resources instead of fossil fuels, the increase will be less—about 2 to 5°F.

In most parts of the United States, the average air temperature has increased since the early 20th century. *Source: EPA's Climate Change Indicators (2016).*

Why does it matter?

Higher temperatures mean that heat waves are likely to happen more often and last longer, too. Heat waves can be dangerous, causing illnesses such as heat cramps and heat stroke, or even death.

Warmer temperatures can also lead to a chain reaction of other changes around the world. That's because increasing air temperature also affects the oceans, weather patterns, snow and ice, and plants and animals. The warmer it gets, the more severe the impacts on people and the environment will be.

Check out the major effects that higher temperatures have on people and the environment:

- Agriculture
- Energy
- Water Supplies
- Health
- Plants, Animals, and Ecosystems
- Forests
- Recreation

More Droughts

A drought is an extended period of dry weather caused by a lack of rain or snow. As temperatures rise due to global climate change, more moisture evaporates from land and water, leaving less water behind. Some places are getting more rain or snow to make up for it, but other places are getting less.

What's happening now?

Since the 1970s, droughts have become longer and more extreme worldwide, particularly in the tropics and subtropics.

What will happen in the future?

Droughts are expected to keep getting longer and more severe. The U.S. Southwest is at particular risk for increasing droughts.

Why does it matter?

A drought means there's less water available for drinking, watering crops, making electricity at hydroelectric dams, and other uses. For example, an ongoing drought in the U.S. Southwest is straining water supplies in states like Nevada and Arizona, where water is already scarce.

Check out the major effects of droughts on people and the environment:

- Water Supplies
- Agriculture
- Forests
- Energy
- Plants, Animals, and Ecosystems

Learn more about droughts by going on an expedition to southwestern Africa!

This map shows the results of computer models that have projected the risk of drought for the years 2090 to 2099. *Source: Adapted from Dai (2011).*

Changing Rain and Snow Patterns

As temperatures rise and the air becomes warmer, more moisture evaporates from land and water into the atmosphere. More moisture in the air generally means we can expect more rain and snow (called precipitation) and more heavy downpours. But this extra precipitation is not spread evenly around the globe, and some places might actually get less precipitation than they used to get. That's because climate change causes shifts in air and ocean currents, which can change weather patterns.

What's happening now?

On average, the world s already getting more precipitation now than it did 100 years ago: 6 percent more in the United States and nearly 2 percent more worldwide.

The effects vary by region, though. For example, states in the Northeast are getting more precipitation than they used to get, but Hawaii is getting less.

The amount of precipitation has changed in various parts of the United States since the early 20th century. *Source:* EPA's Climate Change Indicators (2016).

What will happen in the future?

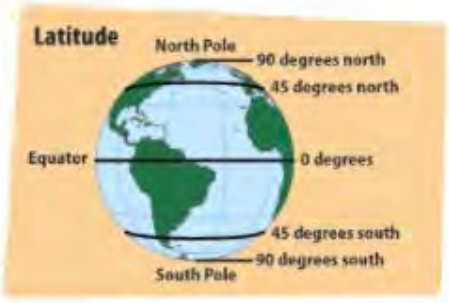
Precipitation is expected to increase in higher latitudes and decrease in areas closer to the Equator. The northern United States will become wetter while the South, particularly the Southwest, will become drier.

Why does it matter?

Too little or too much water can be a problem. In many places, people depend on rain and snowmelt to fill lakes and streams and provide a source of water for drinking, watering crops, and other uses. However, heavy rain can cause flooding.

Check out the major effects of changing rain and snow patterns on people and the environment:

- Agriculture
- Water Supplies
- Energy
- Plants, Animals, and Ecosystems
- Forests
- Recreation



Wilder Weather

Hurricanes and other tropical storms get their energy from warm ocean water. As the top layer of the ocean gets warmer, hurricanes and other tropical storms grow stronger, with faster winds and heavier rain. Because of higher temperatures and increased evaporation, climate change causes other types of storms to get stronger, too.

Higher Temperatures
Changing Rain and Snow Patterns
More Droughts
Warmer Oceans
Rising Sea Level
Wilder Weather
Increased Ocean Acidity
Shrinking Sea Ice
Melting Glaciers
Less Snowpack
Thawing Permafrost

What's happening now?

Over the past 20 years, hurricanes and other tropical storms in the Atlantic Ocean have become stronger. Since the 1980s, the United States has also experienced more intense single-day storms that are dumping a lot more rain or snow than usual.

What will happen in the future?

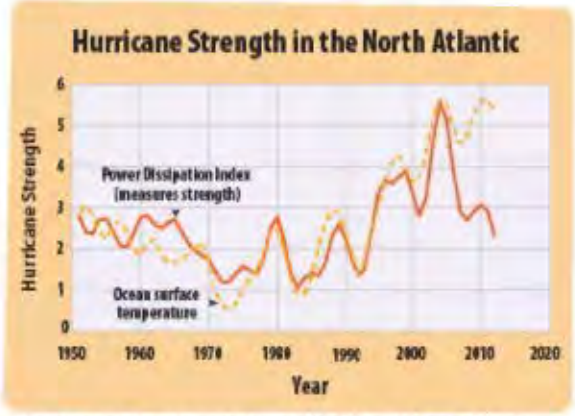
As the climate gets warmer, heavier rainstorms and snowstorms (with more precipitation than normal) are expected to happen more often, and hurricanes around the world could keep getting stronger.

Why does it matter?

Hurricanes and other storms can cause flooding; damage buildings, roads, and other structures; harm crops; and put people's lives in danger.

Check out the major effects of wild weather on people and the environment:

- Coastal Areas
- Recreation
- Health
- Plants, Animals, and Ecosystems



Hurricanes in the northern half of the Atlantic Ocean have become stronger over the last few decades. This graph shows the Power Dissipation Index, which measures total hurricane power each year based on the number of hurricanes and their wind speed. The graph also shows how hurricane strength is related to water temperature. *Source: EPA's Climate Change Indicators (2016).*

Learn more about tropical storms by going on an expedition to the Caribbean and the Gulf of Mexico!

Less Snowpack

Snowpack refers to the total amount of snow and ice on the ground. In high mountain ranges and other cold places, snowpack builds up in the winter and melts in the spring and summer. As the world gets warmer, some places will get more rain instead of snow, so the snowpack won't be as deep. Plus, when the air is warmer, snow melts faster.

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Increased Ocean Acidity
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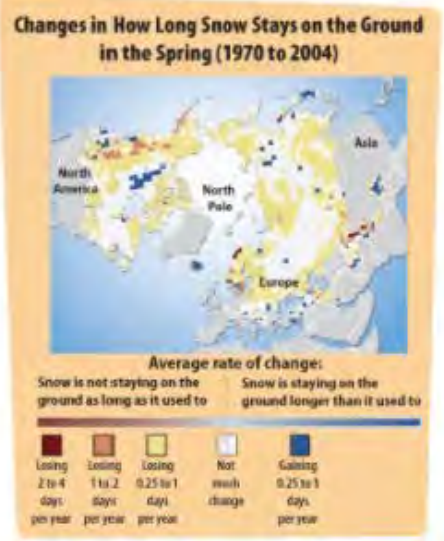
Less Snowpack
Thawing Permafrost

What's happening now?

Many places have less snowpack than they used to, and this snowpack is melting earlier. For example, the map on the right shows that in many parts of North America, Europe, and Asia, snow doesn't stay on the ground in the spring as long as it used to.



Source: Adapted from United Nations Environment Programme/GRID-Arendal (2007).

What will happen in the future?

As temperatures keep getting warmer, snowpack is expected to continue to shrink in most of North America and around the world.

Why does it matter?

When snowpack melts in spring and summer, it provides fresh water for rivers and streams, and it fills reservoirs that supply drinking water to cities and towns. Snowpack is also important for winter sports like skiing and snowboarding.

Check out the major effects of less snowpack on people and the environment:

- Water Supplies
- Recreation
- Energy

Learn more about changes in snowpack by going on an expedition to the European Alps!

Melting Glaciers

Glaciers are large sheets of snow and ice that are found on land all year long. They're found in the western United States, Alaska, the mountains of Europe and Asia, and many other parts of the world. Warmer temperatures cause glaciers to melt faster than they can accumulate new snow.

What's happening now?

Glaciers all over the world have been melting for at least the last 50 years, and the rate of melting is speeding up. Many glaciers in Alaska and other parts of the United States have shrunk dramatically.

Photographs of McCall Glacier, Alaska (1958 and 2003)

Source: Post (1958) and Nolan (2003), National Snow and Ice Data Center.

What will happen in the future?

If temperatures keep rising, glaciers will continue melting, and some could disappear completely.

Why does it matter?

As glaciers and the giant ice sheets on Greenland and Antarctica melt, they add more water into the ocean, which causes sea level to rise.

Check out the effects of melting glaciers on coastal areas.

Shrinking Sea Ice

The Arctic Ocean around the North Pole is so cold that it is usually covered with ice. In the winter, the area covered by ice gets bigger, and in the summer it gets smaller. If the air and water are warmer than usual, Arctic sea ice will melt more than usual during the summer.

What's happening now?

The amount of summer ice in the Arctic Ocean in recent years was the smallest it's been since scientists started using satellites to measure the area covered by ice back in the 1970s. The ice is also getting thinner.

What will happen in the future?

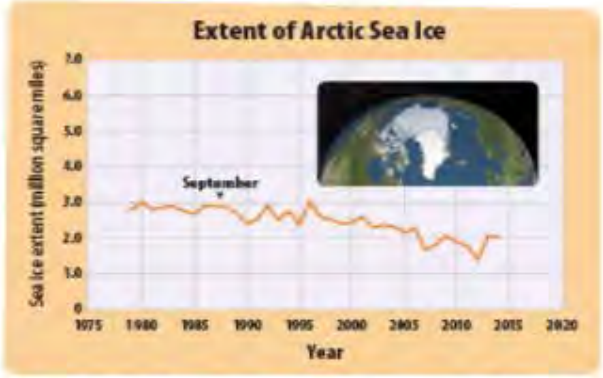
Overall, Arctic sea ice will continue to shrink in the coming decades. However, the amount of sea ice may vary from year to year depending on factors such as local temperatures, wind patterns, and ocean currents.

Why does it matter?

Many animals depend on sea ice for their homes and hunting grounds, and native people in the Arctic need these animals as a source of food. In addition, ice and snow reflect a lot of sunlight back out to space and help keep the planet from getting too warm. If there's less ice, the Earth will absorb more energy from the sun and get even warmer. This is an example of a positive feedback loop, which happens when warming causes changes that lead to even more warming.

Check out the effects of shrinking sea ice on plants, animals, and ecosystems.

Learn more about melting sea ice by going on an expedition to the Arctic!



The number of square miles covered by sea ice in the Arctic Ocean has been decreasing. This graph shows data from September of each year, which is when the amount of ice is usually the smallest. *Source: EPA's Climate Change Indicators (2016).*

Thawing Permafrost

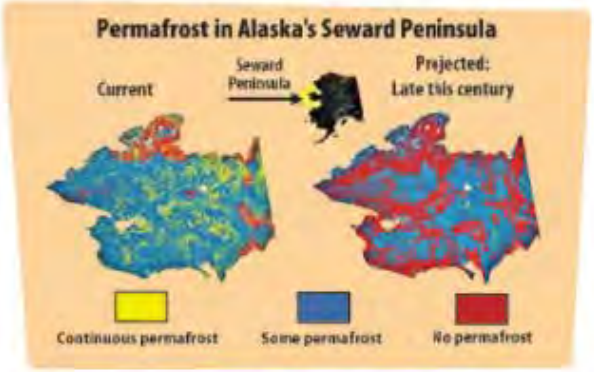
Permafrost refers to a layer of soil or rock that is frozen all year round. Permafrost is found throughout much of Alaska, parts of Canada, and other countries in the far north. You might think a place with permafrost would be barren, but plants can still grow in the soil at the surface, which is not frozen during warmer parts of the year. However, there may be a thick layer of permafrost underneath. As air temperature rises, so does the temperature of the ground, which can cause permafrost to thaw (or melt).

What's happening now?

Ground temperatures have increased throughout Alaska since the late 1970s, and permafrost has already thawed in many places.

What will happen in the future?

As temperatures keep getting warmer, permafrost will continue to thaw. For example, the map on the right shows how permafrost in northwestern Alaska could change by the year 2100.



Source: Adapted from U.S. Global Change Research Program (2009).

Why does it matter?

When permafrost melts, the land above it sinks or changes shape. Sinking land can damage buildings and infrastructure such as roads, airports, and water and sewer pipes. It also affects ecosystems. For example, the top photo shows a forest where the trees are leaning or falling over because the permafrost underneath them has melted.

Another reason to be concerned about permafrost is because it has a lot of carbon trapped inside. As permafrost thaws, this carbon is released to the atmosphere in the form of methane, a powerful greenhouse gas. This process leads to more climate change and is an example of a positive feedback loop, which happens when warming causes changes that lead to even more warming.

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The crops that we grow for food need specific conditions to thrive, including the right temperature and enough water. A changing climate could have both positive and negative effects on crops. For example, the northern parts of the United States have generally cool temperatures, so warmer weather could help certain crops grow. In southern areas where temperatures are already hot, even more heat could hurt crop growth. Global climate change will also affect agriculture and food supply in many other ways.

WHAT'S AT STAKE?

Crop Losses

Climate change could make it too hot to grow certain crops, and droughts caused by climate change could reduce the amount of water available for irrigation. Climate change is also likely to cause stronger storms and more floods, which can damage crops. Higher temperatures and changing rainfall patterns could help some kinds of weeds and pests to spread to new areas. If the global temperature rises an additional 3.6°F, U.S. corn production is expected to decrease by 10 to 30 percent.

- ***What can people do about it?***
  Farmers may be able to prepare for climate change by planting crops during different times of the year, or by planting crops that can survive better in hot and dry conditions.

Learn more

- Take an expedition to the U.S. Midwest to learn more about the effects of climate change on agriculture.
- Find out more about how people can prepare for severe weather and droughts.

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Energy

Global climate change will affect how much energy we need and when we need it. As temperatures rise, more people will need to keep cool by using air conditioning, which uses a lot of electricity. However, some people might need less energy to heat buildings in the winter because it may not get as cold as it used to be. Climate change could also make it harder to produce certain types of electricity, such as hydropower.

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WHAT'S AT STAKE?

Hydropower

As climate change causes precipitation patterns to shift, some areas that currently have plenty of water to make hydropower, such as northern California, might not have enough water in the future. Without enough water to produce electricity, these areas could experience power shortages and blackouts. They might have to use other energy sources to make more of the electricity they need, and if these sources are fossil fuels like coal, oil, or natural gas, more greenhouse gases will be added to the atmosphere.

- ***What can people do about it?***
  If climate change begins to affect hydropower production, people can adapt by using less energy, using energy in more efficient ways, or finding other clean energy sources.

WHAT'S AT STAKE?

Air Conditioning

Climate change will lead to more hot days and more heat waves. As a result, people will need to use more air conditioning to stay cool. As people use more air conditioning, electricity shortages and blackouts could increase. Because most electricity is currently produced by burning fossil fuels, using more electricity to run air conditioners will also add more greenhouse gases to the atmosphere.

- ***What can people do about it?***
  People can plant trees near offices and homes to provide shade and keep them cool naturally. They can also use fans instead of air conditioners when it's not too hot. When air conditioning is needed, people can save energy by setting the thermostat a few degrees warmer. When buying a new air conditioner, people can choose energy-efficient models.

Water Supplies

Climate change is affecting where, when, and how much water is available for people to use. Many parts of the world already have very little water, and climate change could make this problem worse. Rising temperatures, changing precipitation patterns, and increasing droughts will affect the amount of water in lakes, rivers, and streams, as well as the amount of water that seeps into the ground to replenish ground water.

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WHAT'S AT STAKE?

Public Water Supplies

In 2007, a major drought hit the southeastern United States. Lake Lanier, which is the main source of drinking water for the Atlanta area, was reduced to record-low water levels. People had to use less water in their homes and businesses and make other changes, such as not watering their lawns.

- ***What can people do about it?***
  As climate change continues, people might have to prepare for water shortages by using less water.

WHAT'S AT STAKE?

Lakes, Rivers, and Streams

Many places rely on snowmelt to fill the lakes, rivers, and streams that help keep drinking water reservoirs full and provide water to irrigate crops. For example, many parts of the western United States depend on water from the Colorado River, which is fed by melting snowpack in the Rocky Mountains. Less snowpack and earlier snowmelt will reduce the amount of water flowing into the Colorado and other rivers.

- ***What can people do about it?***
  Communities might have to find new sources of water to support their needs. People might also have to adapt by using less water.

Learn more

- Take an expedition to southwestern Africa to explore the connection between climate change and droughts.
- Find out more about how people can prepare for droughts.

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Heat waves, severe storms, air pollution, and diseases linked to climate already threaten people's health in many areas of the world. Global climate change will increase these threats. Some people will be particularly at risk, especially those who are poor, very young or elderly, or disabled, or those who live in coastal areas or big cities.

WHAT'S AT STAKE?

Temperature-Related Illnesses

Heat waves are uncomfortable for everyone, but for infants and young children, the elderly, and people who are already sick, they can be especially dangerous. Extreme heat can cause illnesses such as heat cramps, heat stroke, and even death. A 2003 heat wave in Europe caused about 50,000 deaths, and a 1995 heat wave in Chicago caused more than 600 deaths. In fact, heat waves cause more deaths in the United States every year than hurricanes, tornadoes, floods, and earthquakes combined.

On the flip side, as the world gets warmer, the number of illnesses and deaths related to extreme cold (like hypothermia and frostbite) may decrease.

- ***What can people do about it?***
  People should take precautions on hot days to keep cool. Cities can also set up heat wave warning systems and air-conditioned shelters where people can cool off.

WHAT'S AT STAKE?

Air Pollution

You probably know someone with asthma, or maybe you have this condition yourself. Certain kinds of air pollutants, like ozone, can make asthma and other lung conditions worse. Ozone found high in the atmosphere is called "good ozone" because it protects life on Earth from the sun's harmful ultraviolet rays. Ozone can also be found close to the surface of the Earth, where it is considered "bad ozone" because it's the main ingredient of smog and is harmful for people to breathe. Bad ozone is created from pollutants that go through chemical reactions in the atmosphere. Climate change is likely to increase the amount of bad ozone in the air because more ozone is created when the temperature is warm. Learn more about ozone.

- ***What can people do about it?***
  People can check the daily air quality forecast for their area by looking in the newspaper, on TV, or on weather websites. Air quality alerts can also be found at www.airnow.gov. When ozone levels are high, people should be careful about exercising or working outdoors.

WHAT'S AT STAKE?

Spreading Diseases

Climate change might allow some infectious diseases to spread. As winter temperatures increase, ticks and mosquitoes that carry diseases can survive longer throughout the year and expand their ranges, putting more people at risk. One big concern is malaria, a deadly disease spread by mosquitoes in many hot, humid parts of the world.

- ***What can people do about it?***
  People should take common-sense steps to avoid tick and mosquito bites, and communities can take actions to control mosquitoes, such as removing sources of standing water. It's also important for doctors to know the symptoms of diseases that could be spreading to new areas so they can diagnose and treat their patients.

Learn more

- Take an expedition to Southeast Asia to learn more about the effects of climate change on infectious diseases and people's health.

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Most plants and animals live in areas with very specific climate conditions, such as temperature and rainfall patterns, that enable them to thrive. Any change in the climate of an area can affect the plants and animals living there, as well as the makeup of the entire ecosystem. Some species are already responding to a warmer climate by moving to cooler locations. For example, some North American animals and plants are moving farther north or to higher elevations to find suitable places to live. Climate change also alters the life cycles of plants and animals. For example, as temperatures get warmer, many plants are starting to grow and bloom earlier in the spring and survive longer into the fall. Some animals are waking from hibernation sooner or migrating at different times, too.

WHAT'S AT STAKE?

Disappearing Habitats

As the Earth gets warmer, plants and animals that need to live in cold places, like on mountaintops or in the Arctic, might not have a suitable place to live. If the Earth keeps getting warmer, up to one-fourth of all the plants and animals on Earth could become extinct within 100 years. Every plant and animal plays a role in the ecosystem (for example, as a source of food, a predator, a pollinator, a source of shelter), so losing one species can affect many others.

- ***What can people do about it?***
  Just like people, plants and animals will have to adapt to climate change. Many types of birds in North America are already migrating further north as the temperature warms. People can help these animals adapt by protecting and preserving their habitats.

WHAT'S AT STAKE?

Coral Reefs

Coral reefs are created in shallow tropical waters by millions of tiny animals called corals. Each coral makes a skeleton for itself, and over time, these skeletons build up to create coral reefs, which provide habitat for lots of fish and other ocean creatures. Warmer water has already caused coral bleaching (a type of damage to corals) in many parts of the world. By 2050, live corals could become rare in tropical and sub-tropical reefs due to the combined effects of warmer water and increased ocean acidity caused by more carbon dioxide in the atmosphere. The loss of coral reefs will reduce habitats for many other sea creatures, and it will disrupt the food web that connects all the living things in the ocean.

- ***What can people do about it?***
  To help give coral reefs a better chance of surviving the effects of climate change, swimmers, boaters, and divers should treat these fragile ecosystems with care. People can also support groups working to protect coral reefs.

Learn more

- Take an expedition to the Arctic to learn more about how climate change will affect wildlife that depends on sea ice.
- Take an expedition to Australia's Great Barrier Reef to learn more about how climate change threatens coral reefs.
- Check out Climate Change Wildlife and Wildlands: A Toolkit for Formal and Informal Educators to explore the effects of climate change on wildlife in 11 different parts of the United States.
- Find out more about how people can help plants, animals, and ecosystems deal with climate change.

Effects on People and the Environment

How will climate change affect you? Your community? The environment around you?

Global climate change will affect people and the environment in many ways. Some of these impacts, like stronger hurricanes and severe heat waves, could be life threatening. Others, like spreading weeds, will be less serious. And some effects, like longer growing seasons for crops, might even be good! However, as the Earth keeps getting warmer, the negative effects are expected to outweigh the positive ones.

The more we learn about how climate change will affect people and the environment, the more we can see why people need to take action to reduce the greenhouse gas emissions that are causing climate change. We can also take steps to prepare for the changes we know are coming.

Learn more about how climate change will affect people and the environment in the following ways:

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Forests provide homes for many kinds of plants and animals. They also protect water quality, offer opportunities for recreation, and provide people with wood. Forests are sensitive to many effects of climate change, including shifting weather patterns, drought, wildfires, and the spread of pests like the mountain pine beetle. Unlike some animals, trees can't just get up and move when the temperature gets too hot or other conditions change!

WHAT'S AT STAKE?

Wildfires

Wildfires are already common in the forests and grasslands of the western United States. As the Earth gets warmer and droughts increase, wildfires are expected to occur more often and be more destructive. Wildfires do occur naturally, but the extremely dry conditions resulting from droughts allow fires to start more easily, spread faster, and burn longer. In fact, if the Earth gets just 3.6°F warmer, we can expect wildfires in the western United States to burn four times more land than they do now. Fires don't just change the landscape; they also threaten people's homes and lives.

- ***What can people do about it?***
  As the climate continues to change, people will have to prepare for the risk of increasing wildfires by becoming more aware of the danger, taking extra precautions to prevent fires, not building in fire-prone areas, and being ready to manage fires when they do occur.

Learn more

- Find out more about how people can prepare for the increased risk of wildfires.

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Recreation

In addition to causing all sorts of problems, such as heat waves, droughts, and coastline damage, warmer temperatures could also affect people's jobs, recreational activities, and hobbies. For example, in areas that usually experience cold winters, warmer temperatures could reduce opportunities for skiing, ice fishing, and other winter sports. Also, rising sea level could wash away beaches.

WHAT'S AT STAKE?

Ski Season

As air temperatures continue to rise, ski season won't last as long. Places that are used to getting lots of snow might get more rain instead. Some ski resorts might have to close because of climate change. There may be shorter seasons for other cold weather activities, like outdoor ice skating, snowmobiling, and ice fishing.

- ***What can people do about it?***
  Owners of ski resorts and other businesses (such as hotels and restaurants) that depend on winter sports can take steps to prepare for a shorter or less profitable winter season. For example, some ski resorts have added activities like golf and mountain biking to make money during other parts of the year.

WHAT'S AT STAKE?

Beaches

Higher sea level will mean less space at the beach. A combination of stronger storms and sea level rise could increase the rate of erosion along the coast, and some beaches could disappear altogether.

- ***What can people do about it?***
  People already add sand to certain beaches to replace sand that has washed away. In the future, people might have to replenish beach sand more often, but this will cost more money. In other places, people might choose to build sea walls or other structures to protect the shore from erosion. Ideally, these projects will be planned carefully to prevent them from damaging important habitats for plants and animals.

Learn more

- Take an expedition to the European Alps to learn more about the effects of climate change on winter recreation—and what people can do to prepare.
- Take an expedition to the Maldives to learn more about sea level rise and how it will affect coastal areas.
- Find out more about how people can prepare for rising sea level and stronger coastal storms.

Water Supplies

Climate change is affecting where, when, and how much water is available for people to use. Many parts of the world already have very little water, and climate change could make this problem worse. Rising temperatures, changing precipitation patterns, and increasing droughts will affect the amount of water in lakes, rivers, and streams, as well as the amount of water that seeps into the ground to replenish ground water.

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Droughts and Wildfires

Higher temperatures brought on by climate change are expected to increase the amount of moisture that evaporates from land and water, which will also cause rainfall patterns to shift. In many areas, these changes will lead to more frequent and severe droughts, which occur when an area receives less water than usual. Hot temperatures and dry conditions also increase the likelihood of wildfires. Go on an expedition to southwestern Africa to learn more about drought and climate change.

Learn about who is most affected and some of the things we can do to prepare now and in the future:

Droughts

- Who Is Most Affected?
- If a Drought Happens...
- To Prepare for the Future...

Wildfires

- Who Is Most Affected?
- To Prevent Wildfires...
- To Prepare for the Future...

Climate Challenge

1. Droughts can occur in any climate—hot or cold, dry or humid. True or false? >Reveal answer
   True

2. I am a continent that could be severely affected by droughts due to climate change. Rising temperatures and less rainfall could decrease food production up to 50 percent by 2020. This will increase malnutrition, which already causes 3.5 million deaths here every year. What continent am I?
   Africa

3. On average, how many wildfires occurred each year from 1960 to 2013 in the United States?

   A. 10,000
   B. 100,000
   C. 1 million

   B

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Droughts and Wildfires

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Learn about who is most affected and some of the things we can do to prepare now and in the future:

Droughts

Who Is Most Affected?

- Farmers
- Ranchers
- People living in places that are already dry

If a Drought Happens...

- Conserve water in your home and workplace
- Use irrigation techniques that use less water

To Prepare for the Future...

Wildfires

Who Is Most Affected?

- People living in wildfire-prone areas, such as California and the Rocky Mountain states
- People with asthma or other lung or heart conditions
- Campers
- Hikers

To Prevent Wildfires...

- If you build an outdoor fire, make it safe and make sure it's completely out when you're done
- Don't use stoves, lanterns, or heaters inside a tent
- Have fire

- use irrigation techniques that use less water

To Prepare for the Future...

To Prevent Wildfires...

- If you build an outdoor fire, make it safe and make sure it's completely out when you're done
- Don't use stoves, lanterns, or heaters inside a tent
- Have fire extinguishers on hand

To Prepare for the Future...

- Avoid building homes in extremely fire-prone areas
- Build homes that are more fire resistant
- Plant fire-resistant shrubs and trees around homes

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   True

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Learn more

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Learn more

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WHAT'S AT STAKE?

Disappearing Habitats

As the Earth gets warmer, plants and animals that need to live in cold places, like on mountaintops or in the Arctic, might not have a suitable place to live. If the Earth keeps getting warmer, up to one-fourth of all the plants and animals on Earth could become extinct within 100 years. Every plant and animal plays a role in the ecosystem (for example, as a source of food, a predator, a pollinator, a source of shelter), so losing one species can affect many others.

- ***What can people do about it?***
  Just like people, plants and animals will have to adapt to climate change. Many types of birds in North America are already migrating further north as the temperature warms. People can help these animals adapt by protecting and preserving their habitats.

WHAT'S AT STAKE?

Coral Reefs

Coral reefs are created in shallow tropical waters by millions of tiny animals called corals. Each coral makes a skeleton for itself, and over time, these skeletons build up to create coral reefs, which provide habitat for lots of fish and other ocean creatures. Warmer water has already caused coral bleaching (a type of damage to corals) in many parts of the world. By 2050, live corals could become rare in tropical and sub-tropical reefs due to the combined effects of warmer water and increased ocean acidity caused by more carbon dioxide in the atmosphere. The loss of coral reefs will reduce habitats for many other sea creatures, and it will disrupt the food web that connects all the living things in the ocean.

- ***What can people do about it?***
  To help give coral reefs a better chance of surviving the effects of climate change, swimmers, boaters, and divers should treat these fragile ecosystems with care. People can also support groups working to protect coral reefs.

Learn more

- Take an expedition to the Arctic to learn more about how climate change will affect wildlife that depends on sea ice.
- Take an expedition to Australia's Great Barrier Reef to learn more about how climate change threatens coral reefs.

Severe Weather

Heavy storms and hurricanes are expected to become stronger with climate change and cause more damage to coastal communities. Go on an expedition to the Gulf of Mexico and the Caribbean to learn more about tropical storms and climate change. Heavy storms and flooding also affect people who live in floodplains near rivers, or in cities that don't have good drainage.

Learn about who is most affected and some of the things we can do to prepare now and in the future:

Severe Storms and Hurricanes

Who Is Most Affected?

- People living near the coast
- People living in low-lying areas that flood easily
- Tourists and beachgoers
- Businesses that depend on tourists

During Hurricane Season...

- Pay attention to hurricane warnings
- Have emergency supplies ready
- Have a full tank of gas and be ready to evacuate
- Know the evacuation

Flooding

Who Is Most Affected?

- People living near rivers and streams
- People who live in areas with poor drainage
- Farmers

To Prevent Flooding...

- Keep storm drains clear

To Prepare for the Future...

- Avoid building homes in floodplains
- Plant flood-resistant crops
- Preserve wetlands and other places that can store water

During Hurricane Season...

- Pay attention to hurricane warnings
- Have emergency supplies ready
- Have a full tank of gas and be ready to evacuate
- Know the evacuation route and where emergency shelters are located

To Prepare for the Future...

- Build houses that can withstand strong storms
- Don't build in areas that are likely to flood
- Set up reinforced shelters for people who cannot evacuate
- Preserve natural barriers like sand dunes that provide protection against storms
- Keep storm drains clear

To Prepare for the Future...

- Avoid building homes in floodplains
- Plant flood-resistant crops
- Preserve wetlands and other places that can store water

1. Most of the damage from hurricanes is caused by coastal flooding. True or false?
   True

2. Can you name the most costly hurricane in U.S. history?
   Hurricane Katrina, which hit Louisiana in 2005, was the most costly hurricane in history, causing an estimated $125 billion worth of damage.

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Plants, Animals, and Ecosystems

Plants and animals have adapted to changes in the environment for millions of years. However, today's changes are happening faster and on a larger scale than in the past, which makes it difficult for plants and animals to adapt. Changes in climate can affect the types of plants that can grow in an area. Animals' food supplies, water, life cycles, breeding habits, and ranges will be affected, too.

Some animals will adapt to changing conditions or move elsewhere, but others could have trouble surviving. Some unwelcome invaders (invasive species) could benefit from climate change by expanding their range or being able to survive through the winter in new places.

All these changes will affect the way ecosystems function, and changes to ecosystems affect people, too. That's because we rely on ecosystems to provide us with many services, like clean water, food, and medicines.

Learn what you can do to help plants and animals adapt to climate change:

Preserve Habitats

You can provide wildlife in your very own backyard with food, water, cover, and shelter for raising their young. And it doesn't matter whether your "backyard" is an apartment balcony or a grassy meadow. Visit the National Wildlife Federation's website EXIT Disclaimer to learn more.

Protect Threatened Ecosystems

Coral reefs face a double threat as ocean temperatures rise and seawater becomes more acidic. You can help keep corals healthy by reducing other stresses on reefs. At the beach, be sure to dispose of your trash properly. If you snorkel or dive, don't touch or step on the corals. When boating, steer clear of reefs, and don't drop your anchor near them.

Check out 25 steps, big and small, that you can take even if you don't live near a coast. Take an expedition to Australia to learn more about the threat to coral reefs...and what we can do about it.

Be a Citizen Scientist

apartment balcony or a grassy meadow. Visit the National Wildlife Federation's website EXIT Disclaimer to learn more.

Protect Threatened Ecosystems

Coral reefs face a double threat as ocean temperatures rise and seawater becomes more acidic. You can help keep corals healthy by reducing other stresses on reefs. At the beach, be sure to dispose of your trash properly. If you snorkel or dive, don't touch or step on the corals. When boating, steer clear of reefs, and don't drop your anchor near them.

Check out 25 steps, big and small, that you can take even if you don't live near a coast. Take an expedition to Australia to learn more about the threat to coral reefs...and what we can do about it.

Be a Citizen Scientist

Volunteer to keep records of the seasonal changes you see in nature, such as when certain flowers bloom in the spring. You can be part of a network of citizens who are gathering important information that can help scientists understand how climate change is affecting plants and animals. Learn more about how you can be a scientist, too!

Help America's wildlife refuges manage invasive plants. EXIT Disclaimer

1. I am in danger of extinction because the sea ice where I live is melting. I was recently added to the list of threatened species in the United States. By the way, I live only in the Arctic and not in the Antarctic, as some people think! What am I?
   Polar bear

2. Over the past four decades, bird species that spend the winter in North America have moved further north by an average of:
   A. 15 miles
   B. 25 miles
   C. 35 miles

   C

3. An average water temperature increase of just a few degrees Fahrenheit can cause harmful bleaching in coral reefs. True or false?
   True

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Last updated on 3/3/2016

Health

Heat waves, air pollution, allergens like pollen and ragweed, and diseases linked to climate already threaten people's health in many areas of the world. Global climate change will increase these threats.

- As the Earth gets warmer, there will be more heat waves and they will last longer. More people will be at risk for illnesses like heat stroke and heat exhaustion.
- Warmer weather could also increase the amount of smog that forms in some areas. Smog can irritate your lungs, trigger asthma attacks, and even lead to serious heart and lung diseases.
- A warmer climate is also expected to promote the growth of mold, weeds, grasses, and trees that trigger allergic reactions and asthma in some people.
- Warmer temperatures can allow mosquitoes and other pests to spread to areas that were once too cold for them and allow them to transmit disease for a longer part of the year. Climate change can also increase the risk of waterborne diseases in some areas. Take an expedition to Southeast Asia to learn more about disease and climate change.

Learn about who is most affected and some of the things we can do to prepare now and in the future:

Heat Waves

▾ Who Is Most Affected?

- People living in cities
- Children and elderly people
- People who are poor or living alone and without air

Disease

▾ Who Is Most Affected?

- People in hot, tropical areas
- Campers, hikers, and others who spend time outdoors

Air Pollution and Allergens

▾ Who Is Most Affected?

- People with allergies and asthma (especially children)
- People with heart or lung diseases

- People living in cities
- Children and elderly people
- People who are poor or living alone and without air conditioning
- People with lung or heart diseases

If a Heat Wave Happens...

- Stay inside where it is cool
- Drink plenty of fluids
- Wear cool, loose clothing and hats if you go outdoors
- Check up on friends, relatives, and neighbors who don't have air conditioning and might need help

To Prepare for the Future...

- Set up warning systems to alert people about heat emergencies
- Set up emergency cooling centers for people without air conditioning
- Make cities "cooler" by planting more trees and creating more parks

- People in hot, tropical areas
- Campers, hikers, and others who spend time outdoors

To Keep From Getting Sick...

- Wear long sleeves and pants to avoid insect bites
- Use insect repellent
- Check yourself (and your pets) for ticks after you've been outside
- Know the symptoms of diseases like Lyme disease, and seek immediate medical attention if you suspect a problem

To Prepare for the Future...

- Track cases of infectious disease to see if they are spreading
- Make sure people get proper health care and vaccines

- People with allergies and asthma (especially children)
- People with heart or lung diseases
- People living in cities

To Protect Your Health...

- Check the daily air quality forecast in the newspaper, on TV, on weather websites, or at www.airnow.gov
- Limit outdoor exercise when air pollution is high

To Prepare for the Future...

- Track allergy hotspots
- Reduce air pollution

1. People are most vulnerable to heat waves in the hottest parts of the country. True or false?
   False. Areas at most risk are those that experience a wide range of temperatures, where air conditioning is less common, and where people are not used to very hot temperatures.

2. Plants produce about 1 billion grains of me in an average season. Climate change could boost my production by as much as 60 to 90 percent in some areas. When some people are around me, they sneeze a lot. What am I?
   Pollen

3. Can you name a type of disease that is transmitted by mosquitoes and is strongly influenced by climate conditions?
   Malaria, West Nile virus, dengue, and many other diseases

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Rising Seas

As the Earth heats up, sea level rises because warmer water takes up more space than colder water. This process is known as thermal expansion. Melting glaciers and ice sheets worsen the problem by adding even more water into the oceans.

Rising seas can erode shorelines, make floods more severe, contribute to wetland loss, and allow salt water to enter bodies of fresh water. In some cases, floods could even force people to leave their homes and move elsewhere. If large numbers of people have to move to new areas, it could cause conflict in some countries. Go on an expedition to the Maldives to learn more about rising seas and climate change.

Learn about who is most affected and some of the things that we can do to prepare now and in the future:

Rising Seas

Who Is Most Affected?

- People living in coastal communities
- Tourists and beachgoers
- Businesses that depend on tourists

To Deal With Flooding...

- Use protective barriers like sandbags around buildings and roads
- Have an evacuation plan ready, and evacuate if ordered

To Prepare for the Future...

- Preserve wetlands and floodplains that protect coastlines from flooding and damage

Who Is Most Affected?

- People living in coastal communities
- Tourists and beachgoers
- Businesses that depend on tourists

To Deal With Flooding...

- Use protective barriers like sandbags around buildings and roads
- Have an evacuation plan ready, and evacuate if ordered

To Prepare for the Future...

- Preserve wetlands and floodplains that protect coastlines from flooding and damage
- Protect barrier beaches and reduce erosion
- Improve drainage systems
- Elevate existing structures or build protective barriers in certain places
- Build houses further from the shoreline and other areas that could flood easily

1. How many miles of coastline does the United States have?

   A. 95,000
   B. 75,000
   C. 50,000

   A

2. About what percentage of Americans live in counties along the coast?

   A. 40
   B. 50
   C. 60

   B

3. I am an ancient species. I basically have not changed for more than 350 million years! One of the places where I lay my eggs is on the sandy beaches along Delaware Bay. The sea level is rising here, and my beaches are getting smaller. By the way, I'm related to spiders. What am I?

   Horseshoe crab

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You Can Be a Scientist, Too!

Do you want to learn first-hand about the effects of global climate change on the natural world? Consider lending a hand to scientists by observing the world around you and reporting what you find. Here are some of the types of information you can collect and organizations that need your help:

Track when leaves grow and flowers bloom in the spring:

- National Phenology Network EXIT Disclaimer
- Project Budburst EXIT Disclaimer

Observe migrating birds:

- National Audubon Society EXIT Disclaimer
- Cornell Lab of Ornithology EXIT Disclaimer

Record the hatching and migration of butterflies:

- Monarch Butterfly Studies EXIT Disclaimer

Collect information on coral reefs and reef fish:

- REEF EXIT Disclaimer
- Eyes of the Reef Network in Hawaii EXIT Disclaimer

Monitor invasive species:

- CitSci.org EXIT Disclaimer
- National Wildlife Refuge System EXIT Disclaimer

Learn more about how you can help plants and animals adapt to climate change.

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Warmer Oceans

The atmosphere affects oceans, and oceans influence the atmosphere. As the temperature of the air rises, oceans absorb some of this heat and also become warmer.

Higher Temperatures
Changing Rain and Snow Patterns
More Droughts
Warmer Oceans
Rising Sea Level
Wilder Weather
Increased Ocean Acidity
Shrinking Sea Ice
Melting Glaciers
Less Snowpack
Thawing Permafrost

What's happening now?

Overall, the world's oceans are warmer now than at any point in the last 50 years. The change is most obvious in the top layer of the ocean, which has grown much warmer since the late 1800s. This top layer is now getting warmer at a rate of 0.2°F per decade.

What will happen in the future?

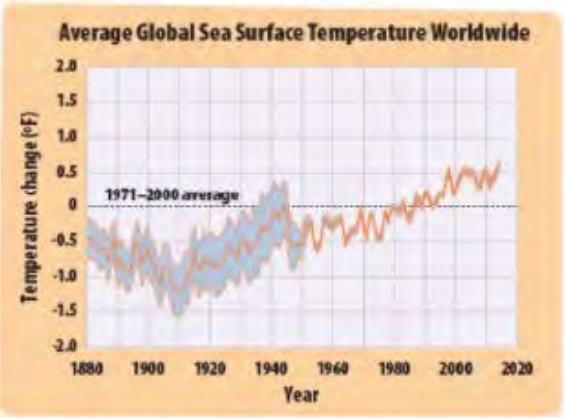
Oceans are expected to continue getting warmer—both in the top layer and in deeper waters. Even if people stop adding extra greenhouse gases to the atmosphere now, oceans will continue to get warmer for many years as they slowly absorb extra heat from the atmosphere.

Why does it matter?

Warmer oceans affect weather patterns, cause more powerful tropical storms, and can impact many kinds of sea life, such as corals and fish. Warmer oceans are also one of the main causes of rising sea level.

Check out the major effects of warmer oceans on people and the environment:

- Plants, Animals, and Ecosystems
- Coastal Areas



The surface of the world's oceans has become warmer overall since 1880. In this graph, the shaded band shows the likely temperature range, which depends on the number of measurements and the methods used at different times. *Source: EPA's Climate Change Indicators (2016).*

Learn more about warmer oceans and sea level rise by going on an expedition to the Maldives!

Increased Ocean Acidity

Carbon dioxide is added to the atmosphere whenever people burn fossil fuels. Oceans play an important role in keeping the Earth's carbon cycle in balance. As the amount of carbon dioxide in the atmosphere rises, the oceans absorb a lot of it. In the ocean, carbon dioxide reacts with seawater to form carbonic acid. This causes the acidity of seawater to increase.

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Thawing Permafrost

What's happening now?

Over the last few decades, the amount of carbon dioxide dissolved in the ocean has increased all over the world, and so has ocean acidity.

What will happen in the future?

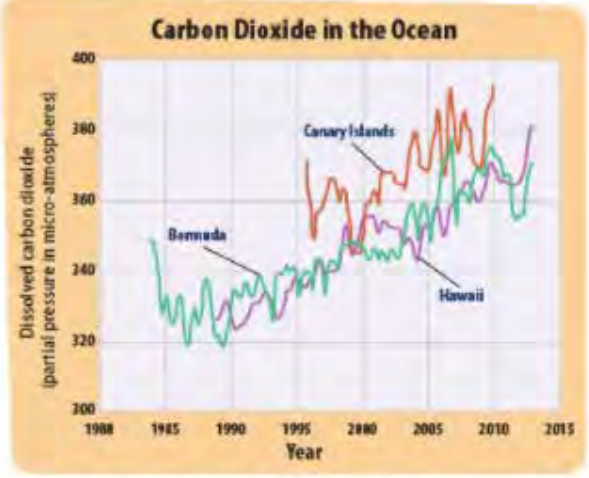
As long as we keep putting extra carbon dioxide in the atmosphere, the acidity of the ocean will continue to increase.

Why does it matter?

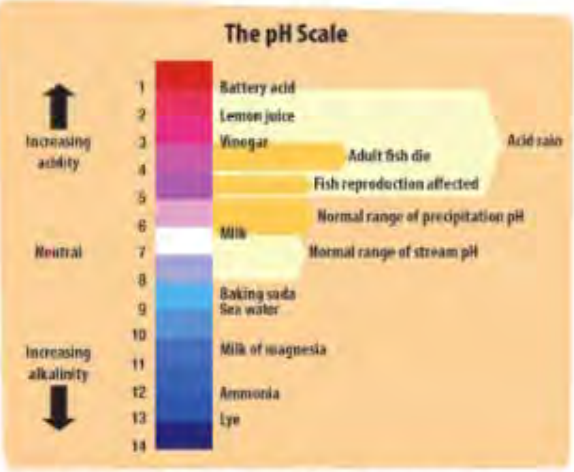
Increasing acidity will make it harder for corals to build skeletons and for shellfish to build the shells they need for protection. Corals are particularly important because they provide homes for many other sea creatures.

Check out the effects of ocean acidity on plants, animals, and ecosystems.

Take an expedition to Australia's Great Barrier Reef to learn more about how climate change threatens coral reefs.



The world's oceans are absorbing more carbon dioxide, as shown by the three sets of measurements in this graph. More carbon dioxide means increased acidity (lower pH). *Source:* EPA's Climate Change Indicators (2016).



Acidity, which is the amount of acid present in a solution, is measured using the pH scale. The lower the pH, the more acidic the substance. *Source: Adapted from* Environment Canada (2010).

Warmer Oceans

The atmosphere affects oceans, and oceans influence the atmosphere. As the temperature of the air rises, oceans absorb some of this heat and also become warmer.

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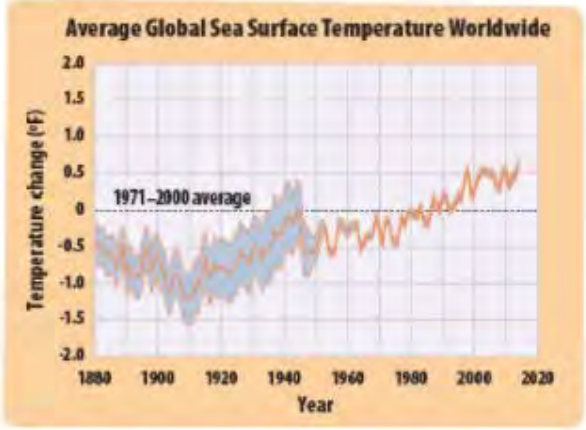

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Learn more about warmer oceans and sea level rise by going on an expedition to the Maldives!

close

Why does sea level change by different amounts in different places?

Sea level is rising faster in some places than others because of wind patterns, ocean currents, and other factors. In addition, sea level may seem like it's changing more in certain places than others because the land itself may be rising or sinking.

In some places, the land is rising or sinking because of plate tectonics—the same forces that cause earthquakes, create volcanoes, and build mountain ranges. In addition to plate tectonics, land can also sink because people have pumped lots of oil, natural gas, or water out of the ground. When the land is also rising, sea level rise might not seem so bad. But in coastal areas where the land is sinking, the effects of sea level rise will be even worse.

Rising Sea Level

As water gets warmer, it takes up more space. Each drop of water only expands by a little bit, but when you multiply this expansion over the entire depth of the ocean, it all adds up and causes sea level to rise. Sea level is also rising because melting glaciers and ice sheets are adding more water to the oceans.

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What's happening now?

Over the past 100 years, the average sea level around the world rose by nearly 7 inches. Did you know that sea level can change by different amounts in different places? Find out why.

What will happen in the future?

If people keep adding greenhouse gases to the atmosphere, the average sea level around the world by the end of this century (the year 2099) could be anywhere from 7 to 23 inches higher than it was in 1990. Sea level could rise even more if the big ice sheets in Greenland and Antarctica melt faster.

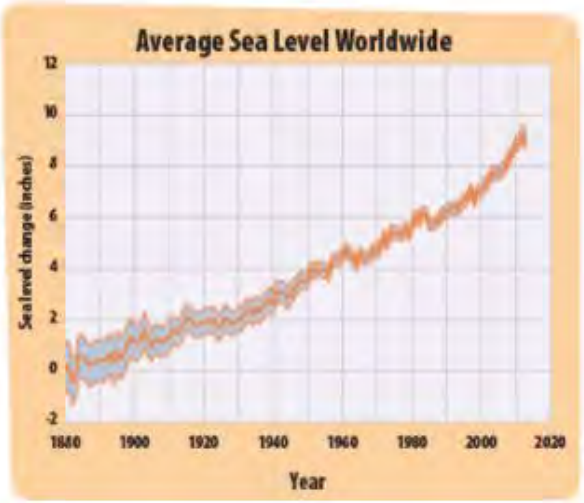
Why does it matter?

Rising sea level is a threat to people who live near the ocean. Some low-lying areas will have more frequent flooding, and very low-lying land could be submerged completely. Rising sea level can also harm important coastal ecosystems like mangrove forests and coral reefs.

Check out the major effects of rising sea level on people and the environment:

- Coastal Areas
- Recreation
- Plants, Animals, and Ecosystems

Learn more about rising sea level by going on an expedition to the Maldives!



Average sea level around the world has been rising for many years. In this graph, the shaded band shows the likely range of sea level, which depends on the number of measurements and the methods used at different times. *Source: EPA's Climate Change Indicators (2016).*

Coastal Areas

Global climate change threatens coastlines and the buildings and cities located along them. Hundreds of millions of people around the world live in low-lying areas near the coast that could be flooded as the sea level rises. Rising sea level will also erode beaches and damage many coastal wetlands. Rising sea level and stronger storms caused by warmer oceans could completely wipe out certain beaches and islands.

Health
Agriculture
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Plants, Animals, and Ecosystems
Forests
Coastal Areas
Recreation

WHAT'S AT STAKE?

Coastal Cities

Climate change poses risks for cities near the ocean. Places like Miami; New York City; New Orleans; and Venice, Italy, could flood more often or more severely if sea level continues to rise. If that happens, many people will lose their homes and businesses.

- ***What can people do about it?***
  Coastal cities can prepare for climate change by protecting or restoring natural shoreline buffers like sand dunes and wetlands, improving storm drainage systems, and building protective barriers where necessary.

WHAT'S AT STAKE?

Coastal Wetlands

Climate change will damage coastal wetlands all over the world. Wetlands protect the shore from flooding, and they also provide important habitats for many types of plants and animals. For example, the Everglades are wetlands close to sea level in southern Florida that are home to diverse ecosystems. As sea level rises, salt water could flood parts of the Everglades, leaving animals such as birds, alligators, turtles, and panthers with less habitat.

- ***What can people do about it?***
  People can protect wetlands as much as possible by not disturbing the land, the flow of water, or plants in these areas.

Learn more

- Take an expedition to the Maldives to learn more about sea level rise and how it will affect coastal areas.
- Find out more about how people can prepare for rising sea level and stronger coastal storms.

Coastal Wetlands Vulnerable to Sea Level Rise Along the Mid-Atlantic Coast

This map shows how rising sea level threatens wetlands along the U.S. Mid-Atlantic Coast. The more vulnerable a wetland is, the more likely it will become submerged (and disappear) as sea level rises in the future. *Source: Adapted from U.S. Climate Change Science Program (2009).*

Recreation

In addition to causing all sorts of problems, such as heat waves, droughts, and coastline damage, warmer temperatures could also affect people's jobs, recreational activities, and hobbies. For example, in areas that usually experience cold winters, warmer temperatures could reduce opportunities for skiing, ice fishing, and other winter sports. Also, rising sea level could wash away beaches.

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WHAT'S AT STAKE?

Ski Season

As air temperatures continue to rise, ski season won't last as long. Places that are used to getting lots of snow might get more rain instead. Some ski resorts might have to close because of climate change. There may be shorter seasons for other cold weather activities, like outdoor ice skating, snowmobiling, and ice fishing.

- ***What can people do about it?***
  Owners of ski resorts and other businesses (such as hotels and restaurants) that depend on winter sports can take steps to prepare for a shorter or less profitable winter season. For example, some ski resorts have added activities like golf and mountain biking to make money during other parts of the year.

WHAT'S AT STAKE?

Beaches

Higher sea level will mean less space at the beach. A combination of stronger storms and sea level rise could increase the rate of erosion along the coast, and some beaches could disappear altogether.

- ***What can people do about it?***
  People already add sand to certain beaches to replace sand that has washed away. In the future, people might have to replenish beach sand more often, but this will cost more money. In other places, people might choose to build sea walls or other structures to protect the shore from erosion. Ideally, these projects will be planned carefully to prevent them from damaging important habitats for plants and animals.

Learn more

- Take an expedition to the European Alps to learn more about the effects of climate change on winter recreation—and what people can do to prepare.
- Take an expedition to the Maldives to learn more about sea level rise and how it will affect coastal areas.
- Find out more about how people can prepare for rising sea level and stronger coastal storms.

Think Like a Scientist

Uncover the cause of today's global climate change.

Did you know that thousands of measurements of the Earth's air, water, and land are taken every day? These measurements come from weather stations, airplanes, ships, satellites, and many other sources all around the globe. Taken all together, these measurements and other observations tell us that the Earth's climate is warming, people are the main cause, and impacts on society and the environment are already happening.

- Examine the clues of climate change.
- Learn about greenhouse gases in the atmosphere.
- Find out how we know that today's climate change is caused by people putting greenhouse gases in the atmosphere.
- See how scientists put together the climate change puzzle.
- Learn how you can help scientists study the effects of climate change.

TAKE A CLIMATE CHANGE EXPEDITION!
join us!

A Scientist's Toolbox
Check out this slide show to learn more about the many tools scientists use to study the Earth's climate.

did you know?
The greenhouse gases people put into the atmosphere now will affect how warm the Earth will become in the future.

Last updated on 3/3/2016

Clues of Climate Change

Scientists look in many places to find clues about climate change. For example, they examine historical records; collect measurements; and observe trends in temperature, weather patterns, sea level, and other features of the environment. Because there are so many clues from all over the world, we know that climate change is already happening today.

Eleven signs of climate change are hidden in the landscape below. Can you find them all? When you get close to each answer, you'll see a magnifying glass, which means it's time to click and reveal a clue!

Learn more about the many signs of climate change.

Clues of Climate Change

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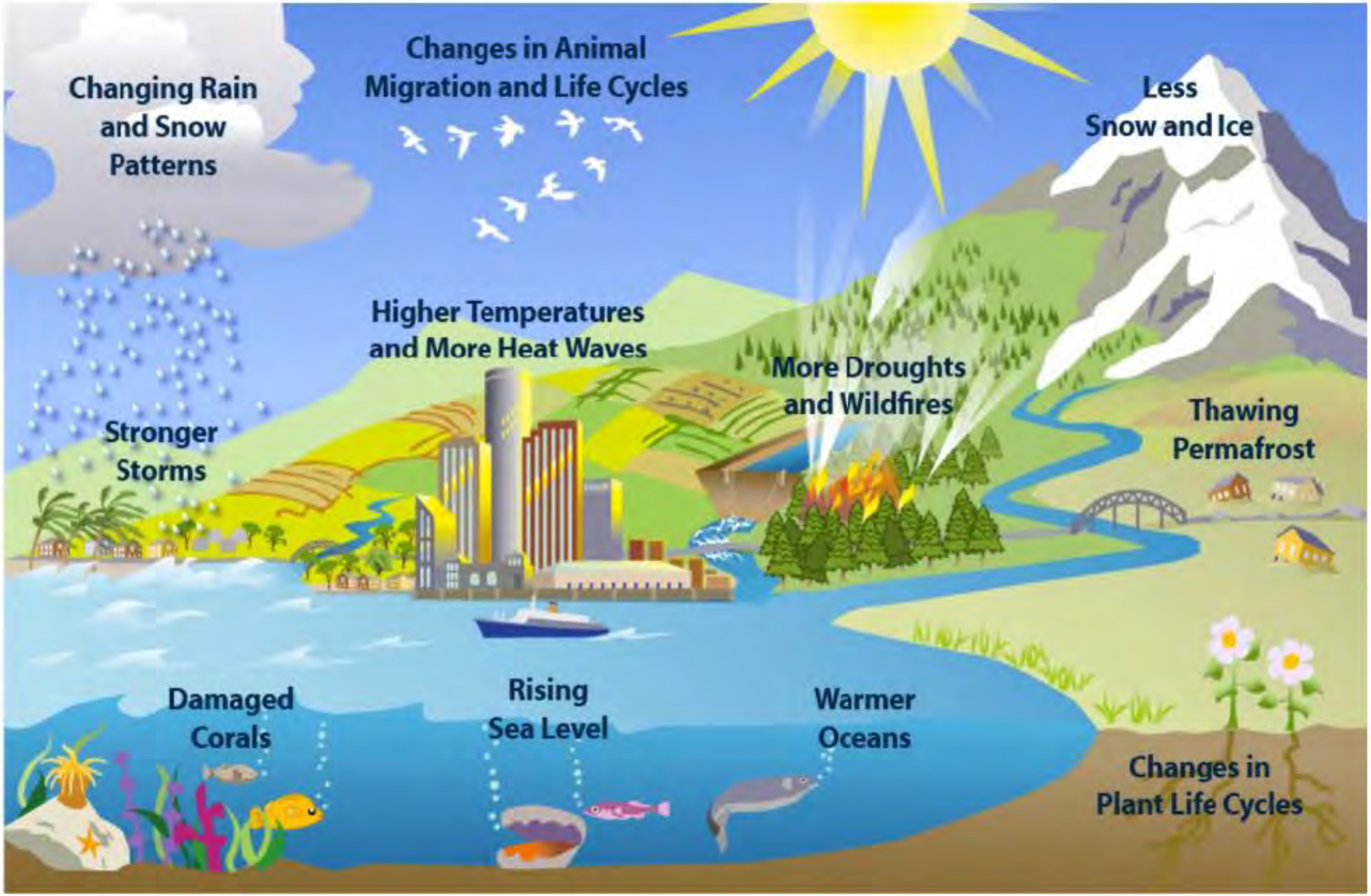


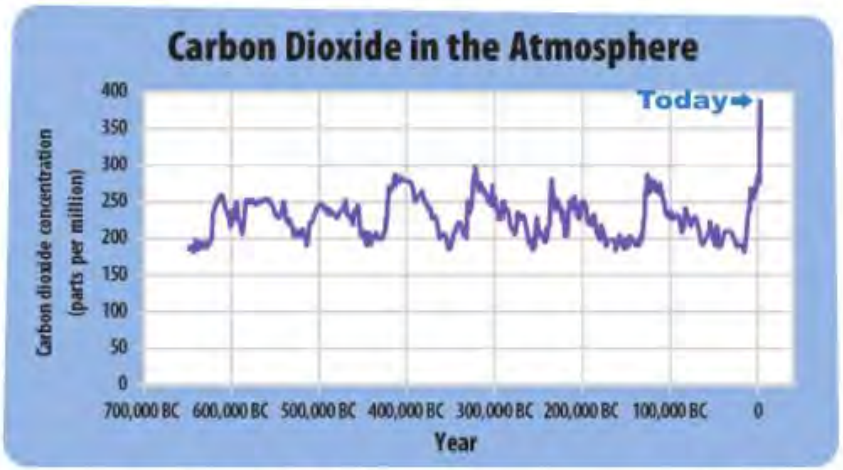
The Proof Is in the Atmosphere

How do we know the amount of greenhouse gases in the atmosphere is increasing?

Scientists measure the amount of greenhouse gases in the atmosphere in several ways. They use satellites and other instruments to measure the amount of greenhouse gases in the air all around the world. They also collect samples of air from specific places and then analyze these samples in a laboratory.

The Earth also gives us clues about the levels of greenhouse gases that existed in the past. For example, ancient air bubbles trapped deep in the ice of Greenland and Antarctica reveal how much carbon dioxide was present long ago.

Scientists have carefully examined all this evidence and made a startling discovery. There's more carbon dioxide in the atmosphere now than at any other time in at least 650,000 years! And the amount of carbon dioxide and other greenhouse gases is continuing to increase.



Scientists can compare the amount of carbon dioxide in the atmosphere today with the amount of carbon dioxide trapped in ancient ice cores, which show that the atmosphere had less carbon dioxide in the past. *Source: EPA's Climate Change Indicators (2016).*

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Last updated on 8/30/2016

Ruled Out

Many factors, such as the sun, the Earth's orbit, and sometimes even volcanic eruptions, can affect the Earth's climate. Scientists use climate models to look at all these factors and determine what is causing climate change. They find that there's only one clear explanation for what's happening now: Extra greenhouse gases in the atmosphere are warming the Earth. Learn more about climate models.

Climate Challenge

Can you rule out natural factors as the main cause of today's climate change?

Examine the facts by clicking on the images below, and then make your decision.

The Sun

The Earth's Orbit

Volcanoes

Ruled Out

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The Sun

The facts: Since the 1970s, the sun has been cooling slightly. Over this same time period, the Earth has gotten warmer. Most of the warming has occurred in the lower atmosphere near the Earth's surface.

Could the sun be responsible for today's climate change?

No. If the sun were the cause of climate change, the Earth's temperature would be cooling, not warming! Also, if the sun were responsible for the increased warming, it would occur throughout the entire atmosphere.

So, the sun is NOT the cause of today's climate change.

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The Sun

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Volcanoes

The Earth's Orbit

The facts: The way the Earth tilts on its axis and the way it circles the sun can influence the amount of the sun's energy that reaches the planet. As a result, changes in the Earth's orbit can cause the climate to change, but these changes happen very slowly, over tens to hundreds of thousands of years.

Could the Earth's orbit be responsible for today's climate change?

No. Cycles in the Earth's orbit happen so slowly that they cannot account for the rapid warming we are seeing today. Also, the current position of the Earth's orbit should result in cooler temperatures, but instead, the opposite is happening—the average temperature of the Earth is getting warmer.

So, the Earth's orbit is NOT responsible for today's climate change.

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The Sun

The Earth's Orbit

Volcanoes

Volcanoes

The facts: When volcanoes erupt, they add a small amount of greenhouse gases into the atmosphere. They also release dust, ash, and other particles called aerosols. Some volcanic explosions are so strong that they throw these aerosols high enough into the atmosphere that they block some sunlight from reaching the Earth.

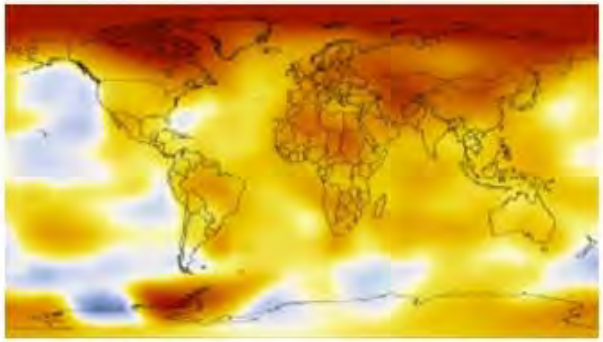
Could volcanoes be responsible for today's climate change?

No. Although volcanoes do add some carbon dioxide (a greenhouse gas) into the atmosphere, people add about 100 times more! The amount of carbon dioxide that comes from volcanoes has not increased, and it's not enough to cause global warming. Actually, the main way volcanoes can change the Earth's climate is by causing a temporary cooling effect. After a very large eruption, particles from the eruption can stay in the atmosphere for as long as a few years, where they block sunlight and make the planet a little bit cooler. This has happened several times in the last 40 years—most recently in 1991 with the eruption of Mount Pinatubo in the Philippines.

So, volcanic eruptions are NOT responsible for today's climate change.

close

A Model Approach



Scientists use models to learn more about current and future changes in the Earth's climate. A climate model is a computer program that uses math equations to describe how the land, the atmosphere, oceans, living things, and energy from the sun affect each other and the Earth's climate. Using these equations, models can predict how a change in one part of the climate system, such as increasing greenhouse gases or decreasing Arctic sea ice, will affect other parts of the Earth in the future.

Some people are concerned that climate models can't mimic how the world really works. But scientists have worked on these types of models for more than 40 years to make sure they get the most important things right. In the same way that video games have improved from simple graphics to very realistic scenery and action, climate models have improved to include details like how clouds form and where it might rain more.

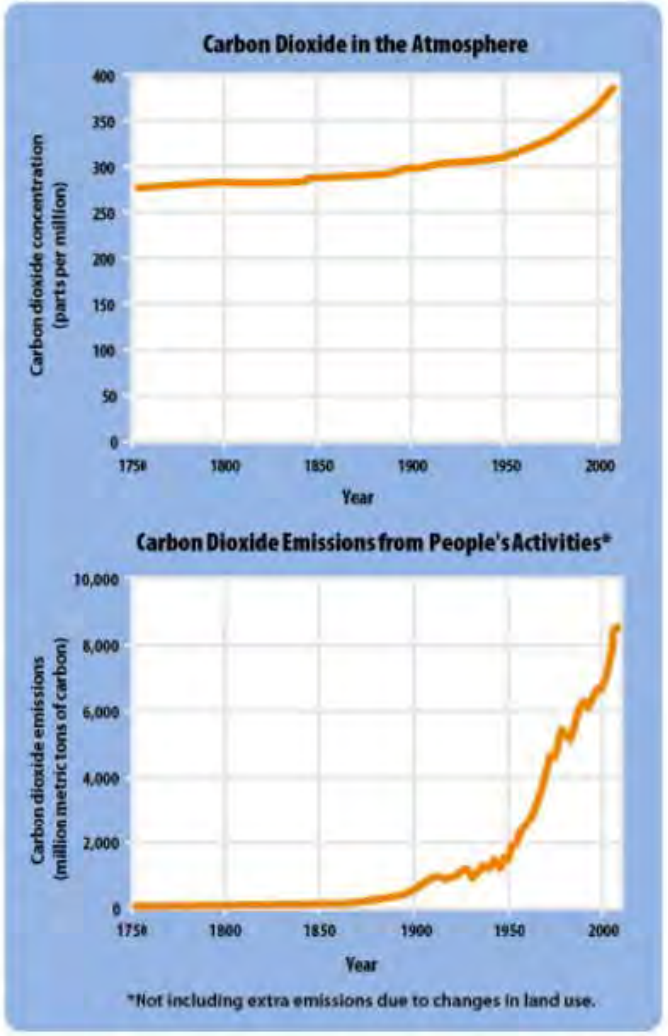
Scientists test their models by comparing the results with real measurements. They only use models that have proven to be useful in understanding past and present changes in the Earth's climate, such as the global temperature changes recorded over the last century. As time goes on, climate scientists will have more and more data to work with, and computers will continue to become more and more powerful and get even better at predicting future climate change.

All the models agree that extra greenhouse gases will cause warmer temperatures, and improved models won't change this basic prediction.

Putting the Pieces Together

By piecing together the evidence, scientists can say that extra greenhouse gases building up in the atmosphere are the main reason for global climate change. But how do they know where the extra greenhouse gases are coming from?

To find out, let's look at carbon dioxide, the most common greenhouse gas. The top graph shows the actual amount of carbon dioxide in the atmosphere from the year 1750 until today. The bottom graph shows how much extra carbon dioxide people around the world have been putting into the atmosphere since 1750. Can you see the connection?



Source: EPA's Climate Change Indicators (2016) and the Carbon Dioxide Information Analysis Center (2010).

The amount of carbon dioxide started to increase a few hundred years ago during the Industrial Revolution, when people started burning a lot of fossil fuels like coal, oil, and natural gas for energy. You can also see that people are burning even more fossil fuels today, which explains why the amount of carbon dioxide in the atmosphere has continued to rise.

Other major greenhouse gases, such as methane, nitrous oxide, and fluorinated gases, are increasing in a similar way.

The Missing Pieces

Scientists know a lot about climate change, and they know that the Earth will continue to get warmer as people add more greenhouse gases to the atmosphere. But there's still more to learn.

Here are some of the questions that scientists are still investigating:

- What amount of greenhouse gases will be added to the atmosphere?

Here are some of the questions that scientists are still investigating:

Source: EPA's Climate Change Indicators (2016) and the Carbon Dioxide Information Analysis Center (2010).

What amount of greenhouse gases will be added to the atmosphere?

The amount of greenhouse gases in the atmosphere in the future will depend on the choices people make. For example, if we continue to depend on coal, oil, and natural gas for most of our energy, the amount of greenhouse gases in the atmosphere will continue to increase. If we decide to switch to more renewable energy sources or use less energy through efficiency or conservation, the amount of greenhouse gases could stop rising and eventually decrease.

How warm will the Earth become?

The Earth's climate is very complicated. Even with advanced computer models, we don't know exactly how all of the Earth's different systems will behave and interact with one another as greenhouse gases increase. So scientists give a *range* of temperature increases that could occur. They predict that:

- If people keep adding greenhouse gases into the atmosphere at the current rate, the average temperature around the world could increase by about 4 to 12°F by the year 2100.
- If we make big changes, like using a lot more renewable resources instead of fossil fuels, the temperature increase will be less—about 2 to 5°F.

Either way, scientists agree that temperatures will increase. They're just not sure by exactly how much, but they are sure that even a 2°F change means that the global climate in the future will be different from today.

How much and how quickly will warmer temperatures lead to other changes?

Scientists know that rising temperatures will cause other changes around the world, and some of these changes have already begun. For example, we know that ice sheets and glaciers are melting, but we don't know exactly how fast or how much more they will melt in the future. But we do know that in general, the more the temperature changes, the more negative the impacts will be. As scientists collect more information, they will be able to make more accurate predictions.

How will climate change affect specific places?

Right now, scientists are better at estimating changes across big areas rather than small areas. For example, they can predict average temperature increases for the whole United States, but they can't say exactly how the temperature might change in your city or town. By collecting more data, scientists are getting better at predicting how climate change will affect specific places.

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Be Part of the Solution!

Do something today to reduce greenhouse gas emissions!

Reducing greenhouse gas emissions is the key to solving global climate change. A major way these gases get into the atmosphere is when people burn coal, oil, and natural gas for energy. Everyone uses energy, and everyone can be part of the solution!

But don't forget that climate change is already happening. We're seeing some of the impacts now, and we'll experience more in the future. So we need to prepare and plan for the changes we know are coming.

- Learn about technologies that reduce the amount of greenhouse gases being added to the atmosphere.
- Discover actions you can take to save energy and slow climate change. Simple actions like turning off lights, conserving water, and recycling all make a difference.
- Explore ways people can prepare for climate change.

What Are Renewable Resources?

Renewable energy resources include sunshine, wind, and flowing water. These resources are renewable because they won't run out or they can be replaced within a few years or decades.

Learn more about renewable resources.

Last updated on 11/11/2016

Technologies

To successfully combat climate change, people will have to switch from getting most of their energy from burning fossil fuels to getting most of their energy from a wide variety of clean energy sources.

Many of these technologies are already available today, while others are still being developed and tested. Clean energy technologies like wind and solar power produce energy without burning fossil fuels. Other technologies reduce greenhouse gas emissions through energy efficiency or by capturing these gases before they can enter the atmosphere.

Explore clean energy and other technologies that reduce the amount of greenhouse gases being put into the atmosphere:

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Last updated on 3/3/2016

Biomass Energy

Biomass is a fancy name for material from plants and animals. Some kinds of biomass can be burned to produce energy. One common example is wood.

Biomass contains stored energy. That's because plants absorb energy from the sun through the process of photosynthesis. When biomass is burned, this stored energy is released as heat.

Burning biomass releases carbon dioxide. However, plants also take carbon dioxide out of the atmosphere and use it to grow their leaves, flowers, branches, and stems. That same carbon dioxide is returned to the air when the plants are burned.

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Many different kinds of biomass, such as wood chips, corn, and some types of garbage, are used to produce electricity. Some types of biomass can be converted into liquid fuels called biofuels that can power cars, trucks, and tractors. Leftover food products like vegetable oils and animal fats can create biodiesel, while corn, sugarcane, and other plants can be fermented to produce ethanol.

Cool Facts

- **Energy from trees.** People can get energy by burning the scrap wood that's left over after trees have been trimmed. It's an efficient way to use a resource that might otherwise get thrown away.
- **Turning trash into electricity.** Waste-to-energy power plants burn trash to produce electricity. They generate enough electricity to supply 1.3 million U.S. homes.

Nuclear Energy

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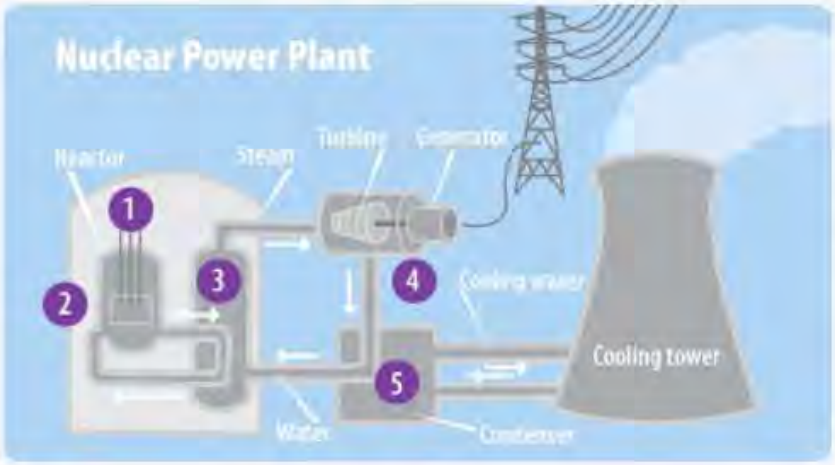
Atoms are tiny particles that make up every object in the universe. The bonds that hold atoms together contain a huge amount of energy. When atoms are split apart, this energy can be used to make electricity. This process is called nuclear fission.

In a nuclear power plant, fission takes place inside a reactor. Most nuclear power plants use uranium as fuel because its atoms are easily split apart. Uranium is a metal found in rocks all over the world. Although uranium is not a renewable resource, fairly large quantities of it still exist, and it only takes a small amount to produce a lot of energy.

Because nuclear power plants don't burn fossil fuels, they don't produce greenhouse gases. But mining and refining uranium requires large amounts of energy. In addition, nuclear power plants produce waste that is radioactive. This waste has to be handled and disposed of according to special regulations designed to protect people and the environment.

How It Works

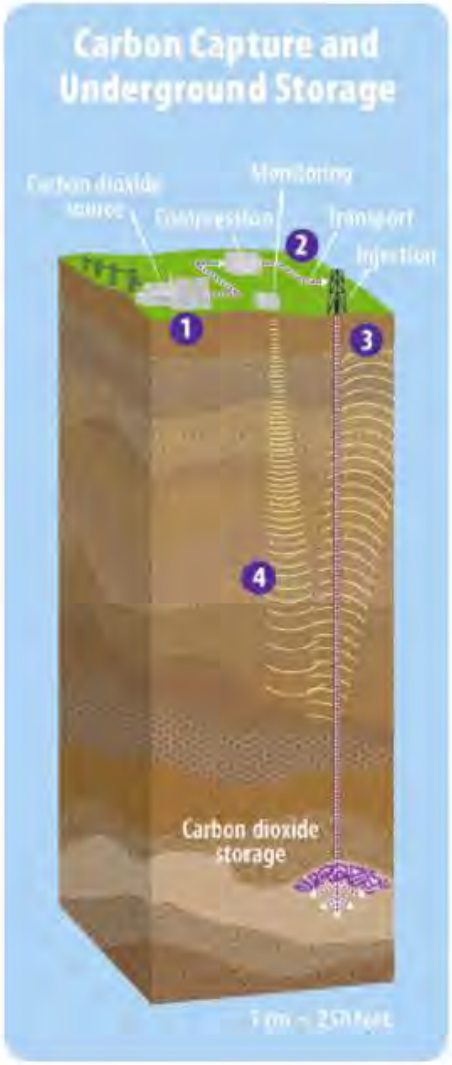


1. In a nuclear reactor, fuel rods full of uranium pellets are placed in water.
2. Inside the fuel rods, uranium atoms split, releasing energy.
3. This energy heats water, creating steam.
4. The steam moves through a turbine, which turns a generator to create electricity.
5. The steam cools back into water, which can then be used over again. At some nuclear power plants, extra heat is released from a cooling tower.

Cool Facts

- **Finding the fuel.** One square mile of earth, one foot deep, typically contains over a ton of uranium. A ton of uranium can produce more than 40 million kilowatt-hours of electricity, which is equal to burning 16,000 tons of coal or 80,000 barrels of oil.
- **Powering Europe.** France gets more than 75 percent of its electricity from nuclear power. Belgium, Sweden, Lithuania, and Ukraine also get large portions of their electricity from nuclear power.
- **Where you live.** The United States has 104 nuclear reactors, which produce about one-fifth of the electricity generated in the United States. Does any of your electricity come from nuclear power? Check out the map to see where nuclear power plants are located.

Carbon Capture and Underground Storage



Currently, most of our electricity is generated at large power plants that burn coal and other fossil fuels that add lots of carbon dioxide to the atmosphere. It will likely be many decades before we can get most of our electricity from renewable resources that emit little or no carbon dioxide. In the meantime, scientists are developing ways to capture carbon dioxide from power plants and factories and safely store it underground so that it can't go into the atmosphere.

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How It Works

1. Carbon dioxide emissions from a power plant or factory are captured so they are not released into the atmosphere.
2. The captured carbon dioxide is sent through a pipeline to a place where underground rock formations can store the carbon dioxide safely and permanently.
3. The carbon dioxide is pumped deep underground (often more than half a mile down).
4. The site is monitored to make sure the stored carbon dioxide doesn't leak back up to the atmosphere or into underground sources of drinking water.

Cool Facts

- **Carbon storage rocks!** Carbon dioxide stored deep in the Earth enters tiny holes in the solid rock, similar to the way water is captured in a sponge.
- **Plenty of room.** The United States has enough space to store 1 to 4 ***trillion*** tons of carbon dioxide. By comparison, the United States emits about 6 *billion* tons of carbon dioxide every year.
- **Put it back.** Rock formations that used to hold oil or natural gas can be great places to store carbon dioxide. People took carbon out of the ground in the form of fossil fuels, and now they can put it back in the same place!

Green Vehicles

How do you get to where you need to go? In the United States, vehicles that burn gasoline and diesel fuel are the main form of transportation for most people. Cars, trucks, buses, airplanes, trains, and other vehicles account for almost one-third of the energy consumed in the United States–and they also produce almost one-third of our greenhouse gas emissions.

While past generations were only able to buy gasoline-powered cars, you will have many more options! Vehicles are now available that use less energy and are better for the environment, and even more of these vehicles will be available in the future.

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- **Fuel-efficient cars** use less gasoline than other cars to travel the same distance. When less gasoline is burned, less carbon dioxide ends up in the atmosphere.
- **Alternative fuel vehicles** run on fuels other than gasoline. Burning natural gas produces less carbon dioxide than gasoline or diesel, and burning hydrogen produces no carbon dioxide at all!
- **Flexible fuel vehicles** can run on gasoline, but they can also use a blend of up to 85 percent ethanol (a fuel produced from corn, sugar cane, or other types of biomass) and 15 percent gasoline, known as E85. These cars have been produced since the 1980s.
- **Electric vehicles** are powered by an electric motor instead of a gasoline engine. From the outside, you might not be able to tell if a car is electric, but you'll see the difference if you look under the hood! Large batteries store energy to power the car, and you just plug it in to refuel. Electric vehicles emit no direct pollution, and if sources like wind and solar are used to generate the electricity, their total carbon dioxide emissions can be very small. You'll see more and more of these cars on the road in the years to come.
- **Hybrid-electric vehicles** combine the benefits of gasoline engines and electric motors. A hybrid car can go up to twice as far on a gallon of gasoline as a typical gasoline-powered car.

Making Cars More Fuel-Efficient

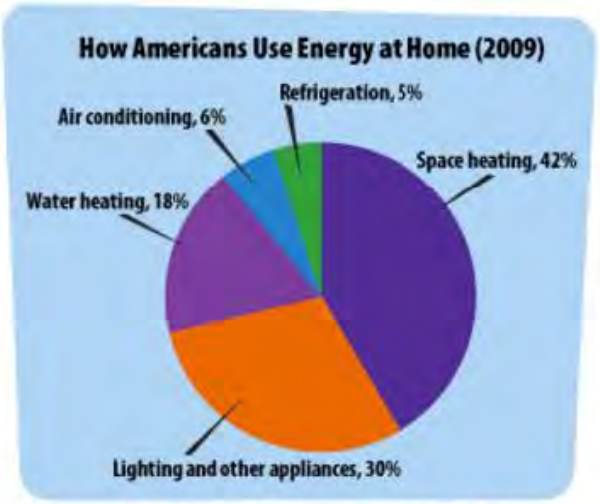
You don't have to buy a new car to save energy!

Select different parts of the car below for a few simple tips to help your family use less gasoline and reduce greenhouse gas emissions.

Cool Facts

- **The car culture.** Americans drive their cars, motorcycles, trucks, and buses a total of 3 trillion miles per year. That's like driving to the sun and back 13,440 times!
- **On the road to savings.** If your family drives 15,000 miles per year, gas costs $3.00 per gallon, and your car gets 30 miles per gallon (MPG), you can save $750 a year compared with a car that gets 20 MPG! You'll also prevent 2.5 tons of carbon dioxide emissions every year.
- **Best in class.** Find the most fuel-efficient vehicle for your family's needs by checking out the annual U.S. fuel economy guide. The guide also provides tips for saving fuel and cash at the pump.

Energy–Efficient Buildings



Source: U.S. Energy Information Administration (2009).

Every day, people flip on light switches, turn on their computers, and use energy in many other ways in their homes, offices, and schools. Using all that power leads to greenhouse gas emissions, especially if the energy is generated from fossil fuels. In fact, the buildings where we live and work account for 30 percent of all greenhouse gas emissions in the United States. Technologies such as more efficient heating, air conditioning, and lighting enable buildings to use less energy, which helps reduce greenhouse gas emissions. Learn more about energy efficiency at ENERGY STAR.

Explore the scene below to learn more about how we can all save energy in our homes.

Source: U.S. Energy Information Administration (2009).

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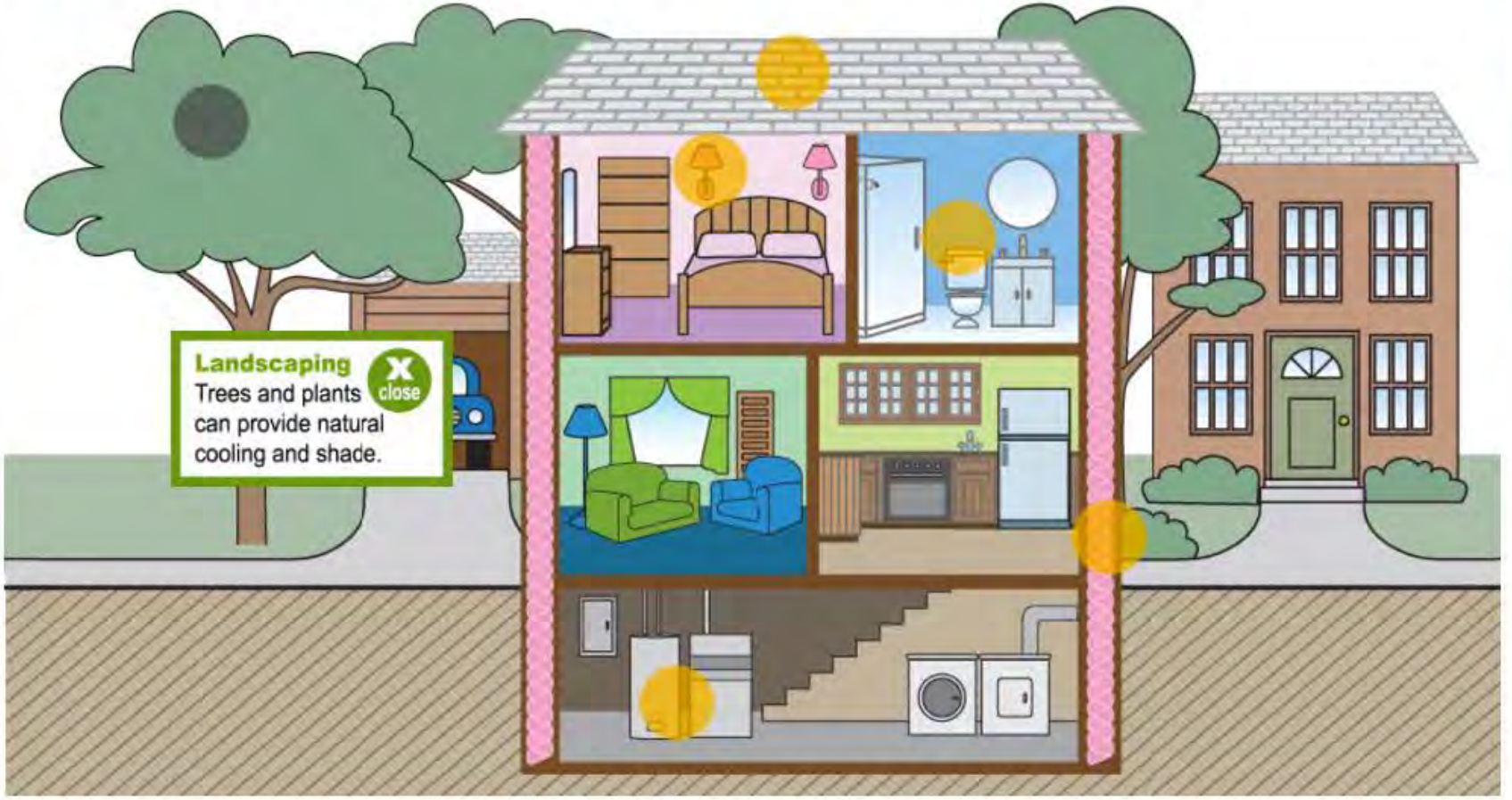

Cool Facts

- **Better bulbs.** ENERGY STAR qualified compact fluorescent light bulbs (CFLs) use about 75 percent less energy than standard incandescent bulbs and last up to 10 times longer.
- **A+ rebuilding.** In New Orleans, the Green Schools Initiative is working to create healthier classrooms and more energy-efficient schools as the city rebuilds after Hurricane Katrina. Learn more. EXIT Disclaimer
- **Green goes to new heights.** New York's Empire State Building is going through a series of renovations that will improve energy efficiency. These changes will reduce energy use by 38 percent and save $4.4 million on heating and electricity bills every year!
- **Battle of the buildings.** A Baton Rouge, Louisiana elementary school took top prize in the 2013 ENERGY STAR National Building Competition by cutting its energy use by 45.9% and saving $294,300. Learn more.

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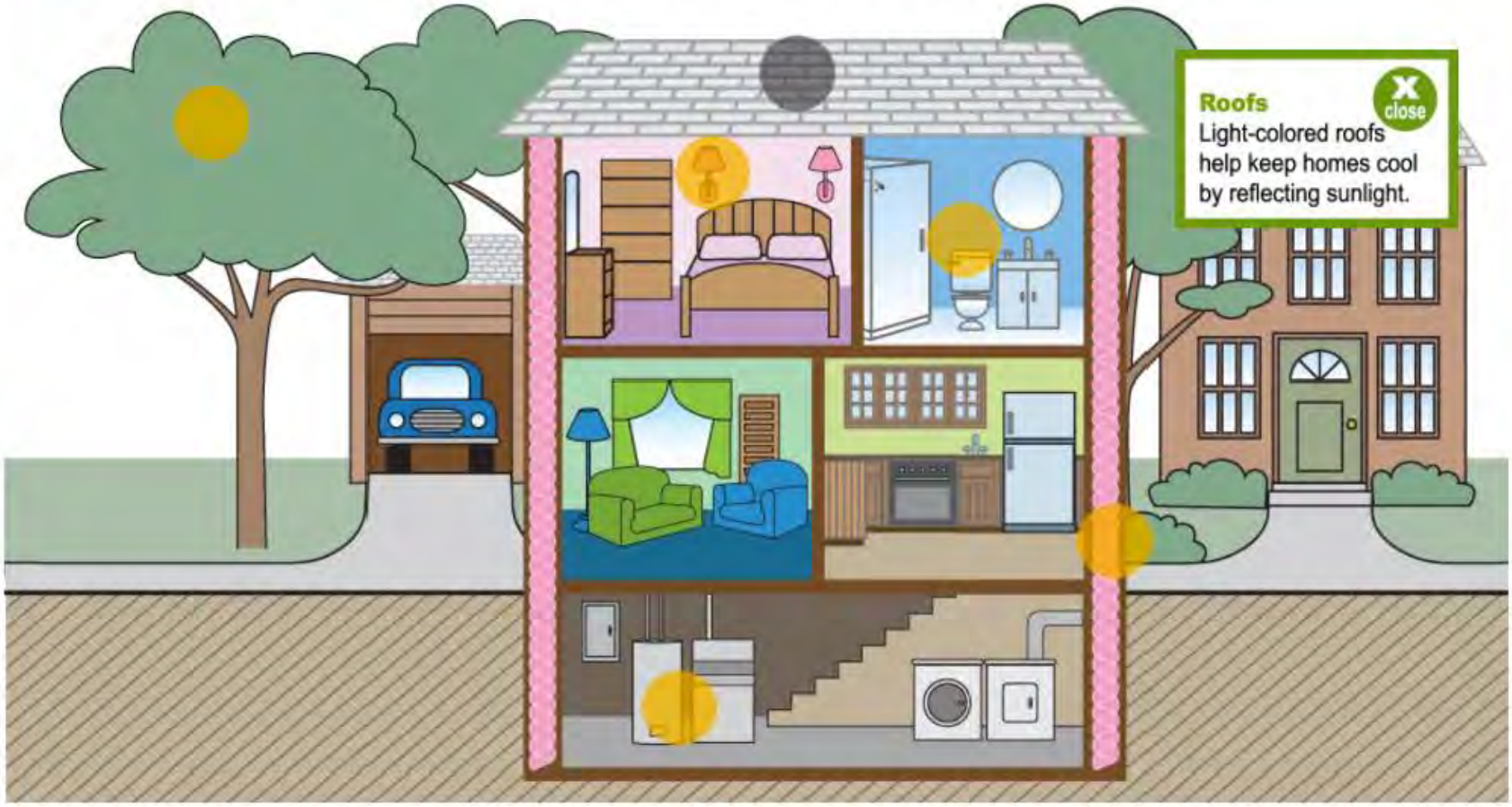

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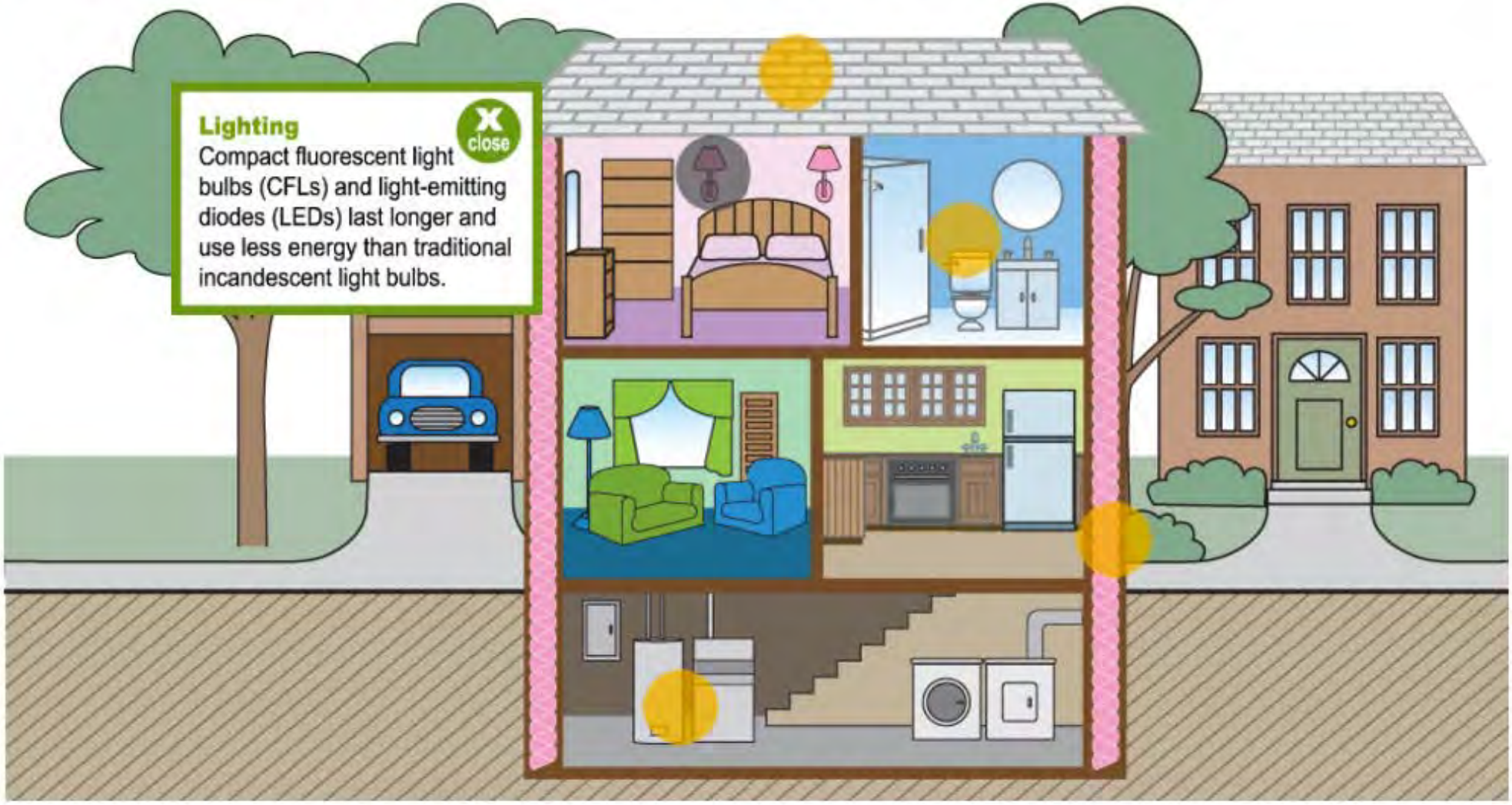
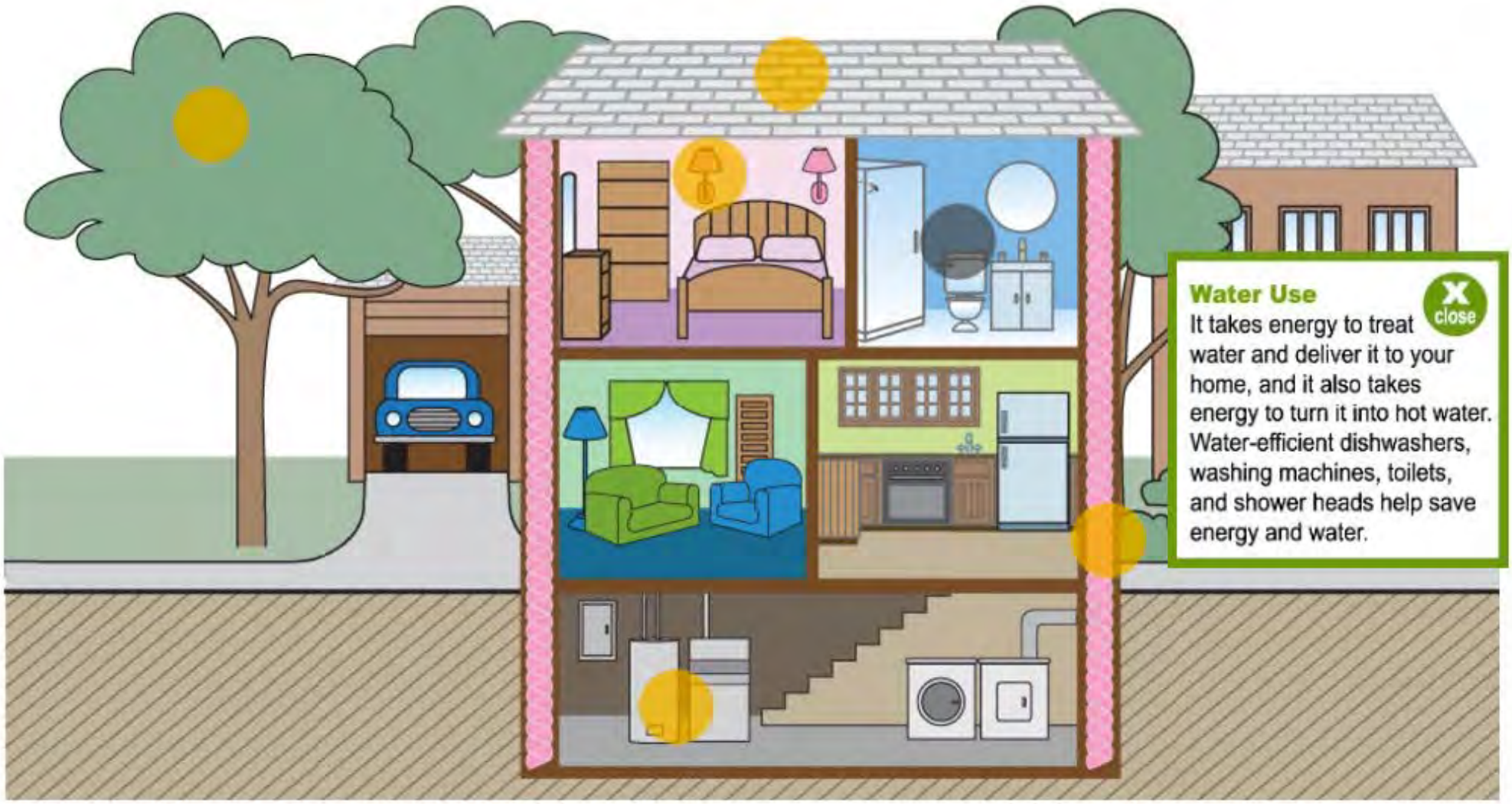
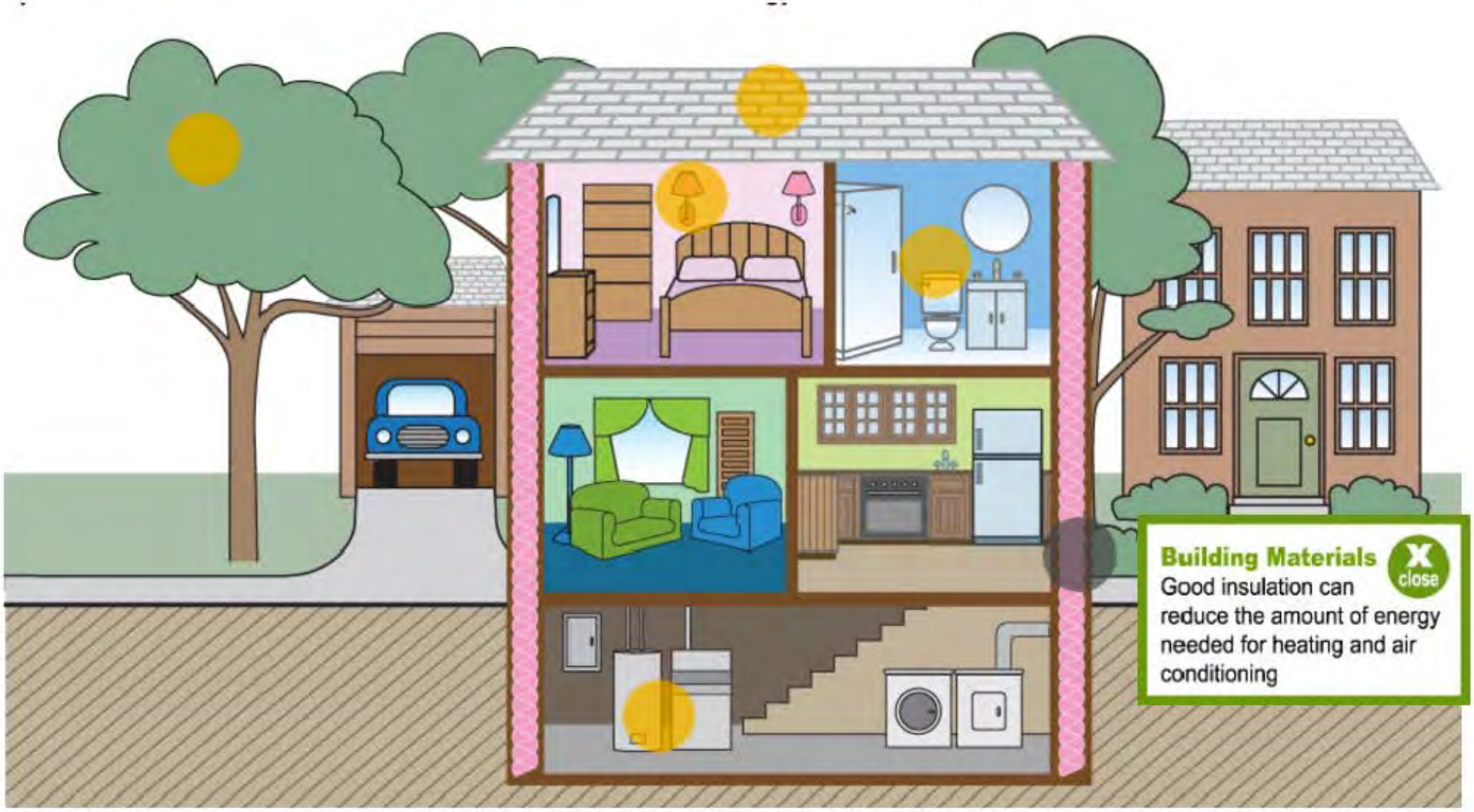
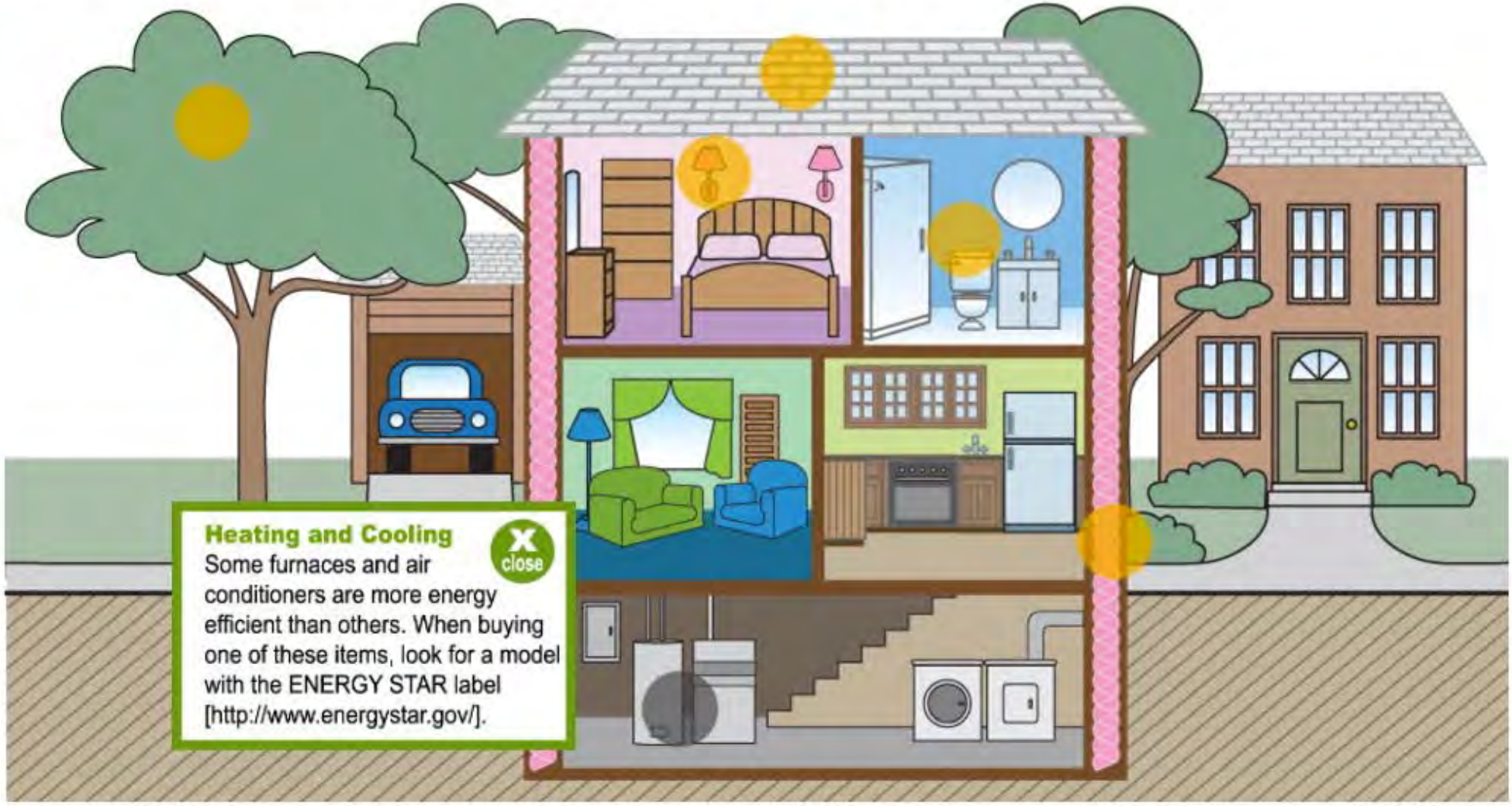



Water Use
close
It takes energy to treat water and deliver it to your home, and it also takes energy to turn it into hot water. Water-efficient dishwashers, washing machines, toilets, and shower heads help save energy and water.


Building Materials
close
Good insulation can reduce the amount of energy needed for heating and air conditioning

Explore the scene below to learn more about how we can all save energy in our homes.



Methane Capture and Use

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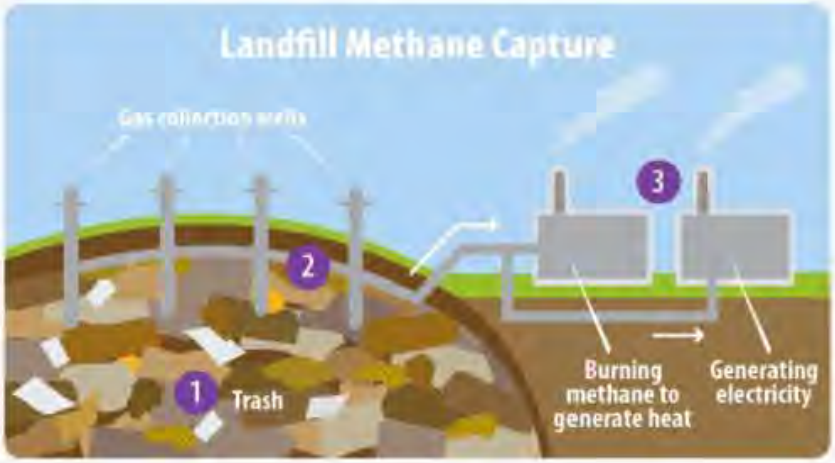
You've probably heard about the three R's. While it's important to reduce, reuse, and recycle as much as you can, it's hard to avoid throwing out some trash every week. Trash that cannot be recycled or reused often ends up in landfills, where it produces methane as it decomposes.

Methane is a very powerful greenhouse gas. One pound of methane traps 25 times more heat in the atmosphere than a pound of carbon dioxide. Methane is also the main ingredient in natural gas. Because methane can be captured from landfills, it can be burned to produce electricity, heat buildings, or power garbage trucks. Capturing methane before it gets into the atmosphere also helps reduce the effects of climate change.

Methane can also be captured from farm digesters, which are big tanks that contain manure and other waste from barns that house livestock such as cows and pigs.

How It Works



1. Trash decomposes (or rots) in landfills, creating methane gas.
2. Methane rises to the top of the landfill and is collected in pipes.
3. The methane is burned to produce heat or generate electricity.

Cool Facts

- **Putting waste to good use.** More than 500 landfill-to-energy projects are currently operating in the United States, and another 500 landfills are good candidates for turning their methane into an energy resource, which would produce enough electricity to power nearly 688,000 homes across the nation.
- **Top producer.** In 2009, Germany produced enough electricity from biogas to power 3.5 million homes.
- **A world first!** Sweden has been operating a biogas-powered train since 2005. It shuttles passengers between two cities that are 75 miles apart.

Wind Energy

The wind can blow your hat off, rustle the trees, and even power your television. For thousands of years, people have used windmills to grind grain and pump water. Today, modern machines called wind turbines are used to make electricity. To produce a lot of electricity, many wind turbines can be placed together on wind farms. Good sites for wind farms are often found on windy hilltops, open plains, and shorelines.

How It Works

1. As the wind blows over the blades of a wind turbine, it causes the blades to lift and rotate.
2. The rotating blades turn a shaft that is connected to a generator.
3. The generator creates electricity as it turns.

Cool Facts

- **Fast as the wind.** Wind power has been the fastest-growing energy source in the world since 1990.
- **The world leader.** Denmark gets one-fifth of its energy from wind power, the highest percentage of any country in the world.
- **Winds of change.** The United States and China are the largest producers of wind power in the world.
- **Power to the people.** In the United States, wind energy now produces enough electricity to power more than 9 million homes.

Geothermal Energy

If you were to dig a big hole straight down into the Earth, you would notice the temperature getting warmer the deeper you go. That's because the inside of the Earth is full of heat. This heat is called geothermal energy.

People can capture geothermal energy through:

- **Geothermal power plants,** which use heat from deep inside the Earth to generate steam to make electricity.
- **Geothermal heat pumps,** which tap into heat close to the Earth's surface to heat water or provide heat for buildings.

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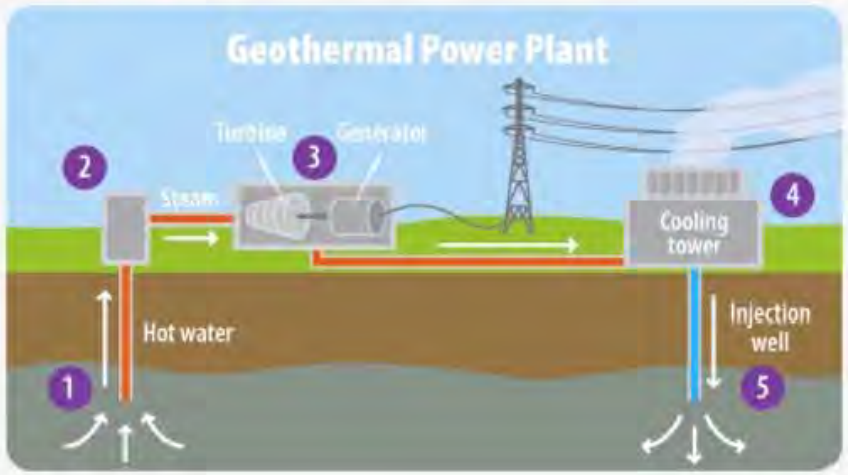
Geothermal Power Plants

At a geothermal power plant, wells are drilled 1 or 2 miles deep into the Earth to pump steam or hot water to the surface. You're most likely to find one of these power plants in an area that has a lot of hot springs, geysers, or volcanic activity, because these are places where the Earth is particularly hot just below the surface.

How It Works



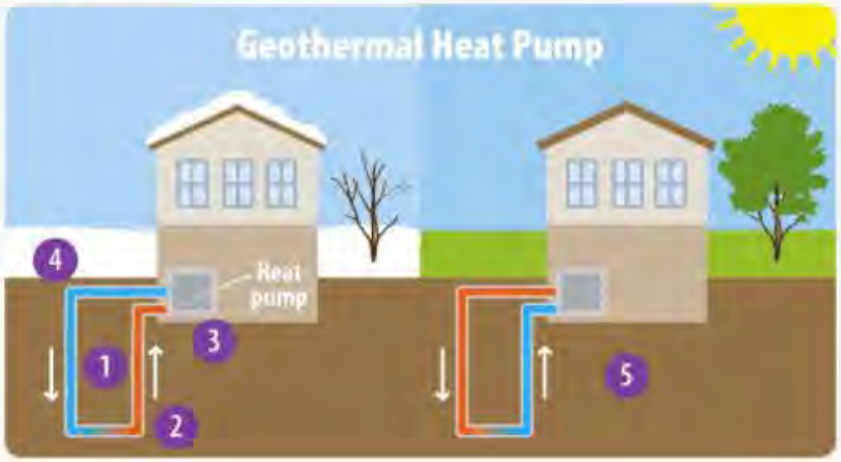
1. Hot water is pumped from deep underground through a well under high pressure.
2. When the water reaches the surface, the pressure is dropped, which causes the water to turn into steam.
3. The steam spins a turbine, which is connected to a generator that produces electricity.
4. The steam cools off in a cooling tower and condenses back to water.
5. The cooled water is pumped back into the Earth to begin the process again.

Geothermal Heat Pumps

Not all geothermal energy comes from power plants. Geothermal heat pumps can do all sorts of things—from heating and cooling homes to warming swimming pools. These systems transfer heat by pumping water or a refrigerant (a special type of fluid) through pipes just below the Earth's surface, where the temperature is a constant 50 to 60°F.

During the winter, the water or refrigerant absorbs warmth from the Earth, and the pump brings this heat to the building above. In the summer, some heat pumps can run in reverse and help cool buildings.

How It Works



1. Water or a refrigerant moves through a loop of pipes.
2. When the weather is cold, the water or refrigerant heats up as it travels through the part of the loop that's buried underground.
3. Once it gets back above ground, the warmed water or refrigerant transfers heat into the building.
4. The water or refrigerant cools down after its heat is transferred. It is pumped back underground where it heats up once more, starting the process again.
5. On a hot day, the system can run in reverse. The water or refrigerant cools the building and then is pumped underground where extra heat is transferred to the ground around the pipes.

Watch a video to learn more about how geothermal heat pumps can heat and cool your home. EXIT Disclaimer

Cool Facts

- **Looking to the past.** People have used geothermal energy for thousands of years. Ancient Romans, Chinese, and Native American cultures used hot mineral springs for bathing, cooking, and eating.
- **Hot stuff!** Most people in Iceland use geothermal energy to heat water and buildings.
- **Ring of Fire.** Many of the best locations for geothermal energy are found in the "Ring of Fire," a horseshoe-shaped area around the Pacific Ocean that experiences a lot of earthquakes and volcanic eruptions. That's because hot magma is very close to the Earth's surface there.

Water Energy

If you've ever stood in a fast-moving stream, under a waterfall, or on the ocean shore as waves come crashing in, then you've felt the power of the water. The energy from moving water can be used to create electricity in several different ways. For example:

- **A hydroelectric dam** captures energy from the movement of a river. Dam operators control the flow of water and the amount of electricity produced. Dams create reservoirs (large bodies of calm water) behind them, which can be used for recreation, wildlife sanctuaries, and sources of drinking water.
- **Wave power** captures energy from waves on the surface of the ocean using a special buoy or other floating device.
- **Tidal power** captures the energy of flowing waters with the help of turbines as tides rush in and out of coastal areas.

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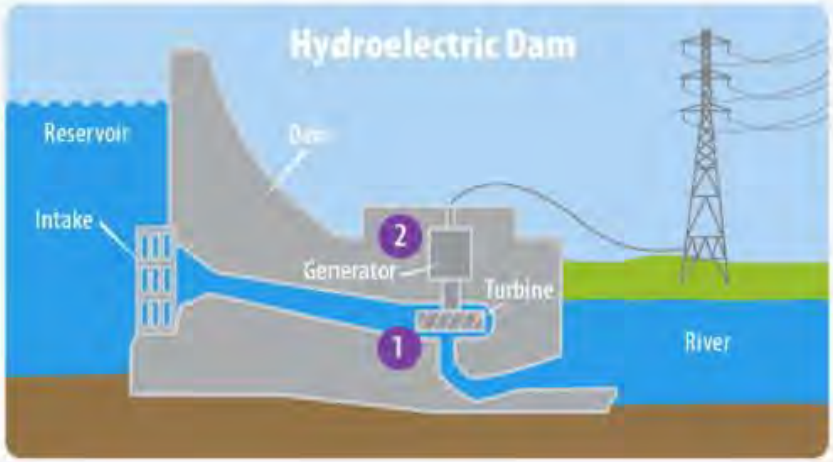


1. Flowing water turns a water wheel or turbine.
2. A generator attached to the turbine produces electricity.

Cool Facts

- **A natural wonder!** Did you know that one of the world's great natural wonders has been generating electricity for more than 100 years? Today, Niagara Falls is the biggest electricity producer in New York State, generating enough electricity to light 24 million 100-watt bulbs at once!
- **Leading the way.** Hydropower is the leading renewable energy source used to generate electricity in the United States.
- **Wave of the future.** The first commercial U.S. power station using ocean waves to generate electricity is in the works in Oregon. When finished, 10 "powerbuoys" in the ocean will generate enough electricity to power 1,000 homes.

Solar Energy

Why is daytime brighter and warmer than nighttime? The answer is simple: solar energy. Solar energy is simply the light and heat that come from the sun.

People can harness the sun's energy in a few different ways:

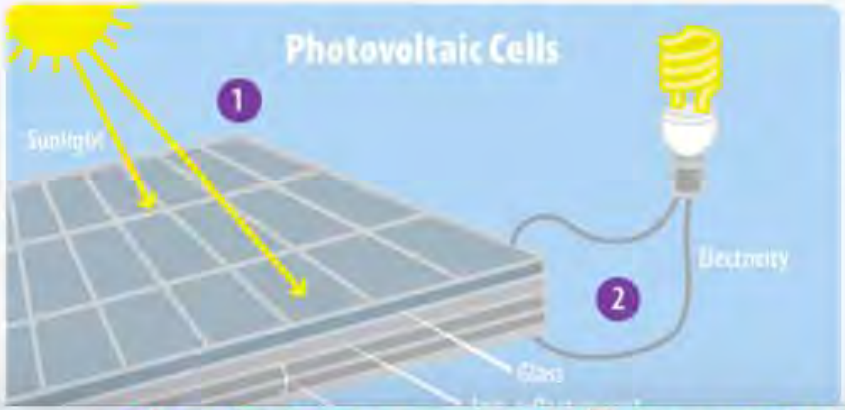
- **Photovoltaic cells,** which convert sunlight into electricity.
- **Solar thermal technology,** where heat from the sun is used to make hot water or steam.
- **Passive solar heating,** which can be as simple as letting the sun shine through windows to heat the inside of a building.

Photovoltaic Cells

Do you have a solar calculator or watch? These items are powered by photovoltaic cells. A photovoltaic cell absorbs light and converts it directly into electricity. A group of photovoltaic cells is known as a solar panel.

You may have seen solar panels on houses, on electronic road signs, or in parking lots to power lights. People who have solar panels on their homes buy less electricity from their utility companies because they're producing some electricity on their own. If you have enough solar panels, you might even be able to generate more power than you need. In some states, this means you can run your electric meter backwards and give your extra electricity to the rest of the community. The electric company ends up paying *you*!

How It Works



1. Sunlight hits the surface of the photovoltaic cell.
2. A material called a semi-conductor converts the light into electricity.

Watch a video to learn more about how photovoltaic cells work.
EXIT Disclaimer

Solar Thermal Technology

Another way to tap solar energy is by collecting the sun's heat. Solar thermal power plants use heat from the sun to create steam, which can then be used to make electricity. On a smaller scale, solar panels that harness thermal energy can be used for heating water in homes, other buildings, and swimming pools.

How It Works

1. Mirrors or reflectors concentrate the sun's rays to heat a special kind of liquid.
2. The heat from this liquid boils water to create steam.
3. Steam spins a turbine that is connected to a generator, which creates electricity.
4. The steam cools and condenses back to water, which is recycled, reheated, and converted into steam again.

Watch a video to learn more about how these systems work. EXIT Disclaimer

Passive Solar Heating

Have you ever noticed how sunlight streaming through a window can make your home feel warmer, even on a cold day? If so, you've seen passive solar heating in action! People can design or remodel buildings to take advantage of heat from the sun during the winter. It helps to have large windows that face south (the side that gets the most sunlight everywhere north of the Equator) and are not shaded by other buildings or trees. A good design often includes overhangs, movable awnings, or blinds that block the sun during the summer when people need to cool their homes instead of heating them.

Cool Facts

- **Solar-powered school buses.** A town in Wisconsin is using solar panels to charge hybrid electric school buses.
- **Google maps for solar panels.** If you live in San Francisco EXIT Disclaimer or Boston EXIT Disclaimer, you can see the solar panels in your neighborhood on a map.
- **How cool is this?** In 2010, China unveiled the first solar-powered air conditioner. If mass-produced, these devices could help reduce energy use and greenhouse gas emissions in China and other countries.
- **Solar joins the major leagues.** Taiwan's National Stadium is being touted as the world's largest sports stadium. It's nicknamed the "flying dragon" after its silver-blue canopy, which coils like a tail and contains nearly 9,000 solar panels. When it's not in use, the stadium powers homes and businesses.

What You Can Do

Can one person help stop global climate change? Yes! Especially when the simple steps you, your friends, and your family take are multiplied by millions of people all over the world.

Select a topic to learn what you can do.

- Switch to Clean Energy
- Use Less Energy
- Travel Green
- Watch Your Water Use
- Reduce Waste
- More Ways to Make a Difference

Switch to Clean Energy

When we get electricity from renewable energy sources like wind and solar power, we avoid the carbon dioxide emissions that would have come from burning fossil fuels like coal, oil, or natural gas.

- **Choose green power.** Talk with your family and school about switching to renewable energy. Explore your options at the Green Power Network's website.
- **Generate your own power.** Can your school or home generate its own renewable energy? Talk with your family and school about the possibility of installing solar panels, a solar water heater, or even a wind turbine.

Use Less Energy

Most of the energy you use at home and at school comes from burning fossil fuels. Using less energy means burning fewer fossil fuels and putting less carbon dioxide into the atmosphere.

- **Power down.** Did you know that some appliances and electronics plugged into an outlet still use power, even when they're turned off? Unplug energy vampires like video game consoles, cell phone chargers, and MP3 players whenever you can. Or consider buying a "smart" power strip, which automatically cuts off power when you turn off an appliance. Visit the ENERGY STAR website for kids to learn more.
- **Do the math.** An energy audit can help you calculate how much energy your family uses at home and identify ways to reduce your energy use. Learn more.
- **Look for the label.** Energy-efficient appliances and electronics typically use between 10 and 50 percent less energy than regular models. If you're shopping for a TV, computer, DVD player, or other electronic device or appliance, look for products that display the ENERGY STAR label. Visit the ENERGY STAR Qualified Products page to learn more.
- **Be energy-wise at school.** Schools can partner with EPA's ENERGY STAR program to reduce their energy use. Talk with your school about what ENERGY STAR schools are doing to save energy, and find out how your school can join.

Last updated on 3/3/2016

Travel Green

Cars, trucks, airplanes, and other kinds of vehicles are responsible for about one-third of the greenhouse gas emissions in the United States. Smart transportation choices can make a big impact on reducing emissions.

- **Walk, bike, skateboard, rollerblade, or take a bus to school.** Just make sure to stay safe. Ask your school to get involved in the Safe Routes to School program. EXIT Disclaimer This program has lots of tips for students and their families, like forming "walking school buses" led by one or two adults.
- **Give the car a break.** Encourage your family to make one big trip to run all their errands at once, instead of making lots of small trips. Consider sharing rides with others, and use public transportation like buses or trains whenever you can.
- **Use your buying power.** When it's time to buy a new car, help your family choose one that's fuel-efficient or electric. You'll use less gas, reduce emissions, and save money. Learn more.
- **Clean up the bus.** Through EPA's Clean School Bus USA program, schools can replace or upgrade older buses so they are more fuel-efficient or run on cleaner fuels.
- **Don't be idle.** Your school bus idles when the engine is running but the bus isn't moving—for example, when your bus driver is waiting to pick you up after school. Running the engine burns fuel, which not only wastes gasoline, but also produces greenhouse gases and other kinds of air pollution. Learn more.

Last updated on 3/3/2016

Watch Your Water Use

Saving water saves energy, which in turn reduces greenhouse gas emissions. It takes a lot of energy to treat the water you use every day to make it safe to drink and to deliver it to your house. It takes even more energy to turn it into hot water. Did you know that letting your faucet run warm water for five minutes uses about as much energy as leaving a 60-watt light bulb on for 14 hours?

- **Be water-wise.** Turn the water off while brushing your teeth, and try taking shorter showers. Learn more ways you can save water, then test your water sense.
- **Fix that faucet.** A faucet that leaks at a rate of one drip per second can waste more than 3,000 gallons of water in a year.
- **Look for leaks.** If your toilet has a leak, you could be wasting 200 gallons of water a day. Try putting a drop of food coloring in the toilet tank. If the color shows up in the bowl without flushing, you have a leak!
- **Keep it cool.** Wash only full loads of laundry, and use cold water instead of hot. About 90 percent of the energy used for washing clothes is for heating the water.
- **Go low-flow.** Talk with your family about installing water-efficient appliances and plumbing fixtures like low-flow showerheads.

Last updated on 3/3/2016

Reduce Waste

Most people don't realize that reducing, reusing, and recycling can help slow climate change. How? To begin with, every product has a life cycle, and every step—from manufacturing to disposal—leads to greenhouse gas emissions. Reducing, reusing, and recycling means you buy (and throw away) less stuff, and that helps reduce the amount of greenhouse gases we're adding to the atmosphere. Learn more about product life cycles.

You can reduce greenhouse gas emissions if you:

- **Reduce.** Reduce the amount of new stuff you buy. To reduce waste, buy things that have less packaging.
- **Reuse.** Try to borrow or rent things you'll only need for a short amount of time, and reuse the things you already have. When you have things you no longer need, give them to others who can use them. Use reusable bags when you go shopping.
- **Recycle.** Remember to recycle whatever materials you can, like bottles, cans, and paper, so they can be collected and remade into new products.
- **Buy recycled.** Choose products made from recycled materials whenever you can.
- **Teach your school the three R's.** Schools can save energy, preserve natural resources, and prevent greenhouse gas emissions by reducing, reusing, and recycling.

Learn more about ways to reduce, reuse, and recycle at school.

Last updated on 3/3/2016

More Ways to Make a Difference

You can take many other actions to help reduce greenhouse gas emissions and global climate change. For example:

- **Plant a tree.** Trees help to slow climate change because they absorb carbon dioxide during photosynthesis. Trees also provide shade, which helps keep streets and houses cooler in the summertime and reduces the need for air conditioning.
- **Consider buying locally grown food.** The further your food travels, the more greenhouse gas emissions are produced in transporting the food from the farm to your plate. You can find locally grown food at a farmers market and even at some grocery stores.
- **Reduce your carbon footprint.** Find out how big your own carbon footprint is, and explore ways you can reduce it.
- **Spread the word.** Give a presentation to your family, school, or community group that explains how their actions can cause or reduce climate change. You can use EPA's "Create a New Climate for Action" presentation (full-screen slides (PDF) (50 pp, 4.44MB, About PDF); presenter notes (PDF) (50 pp, 4.22MB)) or develop your own. Get creative, and think of more ways to help others make a difference! Learn how schools can work together to make a difference.

Last updated on 3/3/2016

Calculator

Your total savings: **5,129** pounds of carbon dioxide per year.

This is equivalent to the emissions from driving a car **5,471** miles.

Instructions | Turn off the tap | Lighten your impact | Stretch those legs | Travel together | Don't trash it | Give it a rest | Your Summary

There are many things you can do to help reduce climate change and its effects on people and the environment. Use this calculator to learn about some simple steps you can take to reduce your impact on the planet.

Instructions:

Select "Yes" if you will take an action, or "I already do this" if you are already taking this action.

Learn about an action by following the "Find out more" link.

See the results of your actions in the box at the top right.

At the end of this exercise, you will also see the total impact if all the students in the United States were to take the same actions as you.

This calculator requires you to have JavaScript enabled. A spreadsheet version (Xlsx) (37K, Excel Viewer EXIT Disclaimer) of the calculator is also available; it includes descriptions of the formulas used in each step of the calculator.

Find Out More

Turn off the water when you brush your teeth. **274 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

Find Out More

Turn off the lights when you are not in your room. **1,135 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

How many hours a day do you leave the lights turned off? 17

Find Out More

Count all of the light bulbs used in your home.
Ask your family to replace incandescent light bulbs with ENERGY STAR bulbs. **655 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

How many light bulbs have you replaced? 10

Find Out More

Calculator

Will you take this action? ○ Yes ○ y do this

How many light bulbs have you re

Find Out More

Bike or walk to school instead o[illegible] 131 pounds of carbon dioxide

Will you take this action? ◉ Yes ○ No ○ I already do this

How many days a week will you bike or walk to school? 2

Reduce car trips for activities outside of school. **0 pounds of carbon dioxide**

Will you take this action? ○ Yes ◉ No ○ I already do this

How many activities outside of school do you currently get a ride to? 5

How many trips will you take by biking or walking instead of getting a ride? 0

Take the bus or other public transportation instead of getting a ride to school. **394 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

How many days a week do you take the bus or other public transportation to school? 2

Find Out More

Ask your family to help arrange a carpool with your friends for going to or from school. **0 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ○ I already do this

How many days a week will you carpool to school?

If you carpool, how many other people will be in the car (excluding you)?

Find Out More

Recycle magazines. **15 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

Recycle newspaper. **90 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

Calculator

Recycle glass. — **7 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ y do this

Recycle plastic. — **19 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

Recycle aluminum and steel cans. — **86 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

Turn off the television when you aren't watching it. — **935 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

How many hours a day do you leave the TV turned off? 20

Find Out More

Turn off video game systems when you aren't using them. — **665 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

How many video game systems do you have? 1

How many hours a day do you leave these devices turned off? 23

Find Out More

Unplug chargers when they are not in use. — **7 pounds of carbon dioxide**

Will you take this action? ◉ Yes ○ No ○ I already do this

How many chargers do you have (for example, cell phone, MP3 player, camera)? 4

How many hours a day will you will you unplug them? 8

Find Out More

Enable the sleep feature on your computer. — **716 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

How many computers do you have? 2

Find Out More

Calculator

How many hours a day do you lea es turned off? 23

Find Out More

Unplug chargers when they are **7 pounds of carbon dioxide**

Will you take this action? ◉ Yes ○ y do this

How many chargers do you have (for example, cell phone, MP3 player, camera)? 4

How many hours a day will you will you unplug them? 8

Find Out More

Enable the sleep feature on your computer. **716 pounds of carbon dioxide**

Will you take this action? ○ Yes ○ No ◉ I already do this

How many computers do you have? 2

Find Out More

Your Summary

Based on what you're already doing, you're avoiding **4,991** pounds of carbon dioxide emissions per year, compared with the average American.

This is equivalent to the emissions from driving a car **5,324** miles.

If you take the additional actions that you checked above, you will avoid another **138** pounds of carbon dioxide emissions per year.

This is equivalent to the emissions from driving a car **147** miles.

Multiply Your Results

If all the students in the United States took the actions you checked, together they would save a total of **387,403,628,000** pounds of carbon dioxide emissions per year.

This is equivalent to the emissions from driving a car **413,230,536,533** miles.

This is equivalent to the annual emissions of **35,055,186** cars.

Find Out More

Previous Section | Next Section

When Schools Work Together

close

If one school can make a difference, then lots of schools working together can make a huge difference. Learn what others are doing and share ideas by getting involved with some of these green programs:

- Green Schools Alliance EXIT Disclaimer
- Green Cup Challenge EXIT Disclaimer
- Project Learning Tree's *GreenSchools!* Program EXIT Disclaimer
- National Wildlife Federation's Eco-Schools EXIT Disclaimer

Educator Resources

EPA developed *A Student's Guide to Global Climate Change* to help provide students (and educators!) with clear, accurate information about the causes and effects of climate change—as well as the steps we can all take to help solve the problem.

Explore the following pages for more tools to help you and your students learn about this increasingly important global issue:

- Lesson Plans: Explore seven lessons tied to *A Student's Guide to Climate Change.*
- Tools and Tips for Educators: Tips for using this website in your classroom.
- Additional Web Resources: Links to other Web resources on climate change, energy, and related topics.

Last updated on 3/3/2016

Take a Climate Change Expedition!

Get your passport ready! It's time to go on a trip around to world to explore the effects of climate change. Each flag on the map below represents a stop on your journey, and you can visit them in any order you like. You'll see a short video at each stop... and you'll also need to complete a few challenges along the way!

Before you begin...

Select any flag on the map to start your journey!

At the end of each stop, you'll get a passport stamp and a code. **Keep track of these codes!** If you collect them all, you can use the red button above to get a certificate.

Last updated on 2/25/2016

close

How Does this Expedition Work?

At each stop on your journey, you'll see a 5- to 10-minute video. Make sure to turn on your speakers or plug in your headphones so you can hear the sound. Here are some of the controls that you'll see on your screen:

Depending on your Internet connection speed, the video might pause occasionally to allow the rest of the file to download. Please be patient!

Each video will pause a few times to ask you a question. Use your mouse to choose the answer you think is correct. Then click the blue button that says "Try Again," "Next," or "Continue."

At the end of each video, you'll receive a passport stamp and a code:

Enter your codes on the tracking sheet. When you collect all of the codes, click the special button on the expedition page and follow the instructions to earn your reward.